§ 51.

H.—TOOLS OPERATING BOTH BY SCISSION AND PARING.

WOOD-LATHES—GAUGE-LATHES—LATHES FOR IRREGULAR FORMS—DOWEL, PIN, AND ROD MACHINES.

Any tool whose cutting action is in a plane transverse to that to which the fibers are parallel must first sever them and then split or pare the severed fibers from the stock. In the paring-tools hitherto discussed at the moment of severing the chips the cutting-edge has been moving parallel to the axis of the material. The feed has been at right angles to the axis, around which the cutter-knives were revolving. In the remaining class the feed will be in a plane parallel to the axis of the cutters, and the latter will act at right angles to the axis of the material. The ordinary wood-lathe illustrates this. The work revolves with its fibers at right angles to the axis of the turning chisel. The latter is fed along the rest parallel to the axis of the cylinder which is being formed. The cutter must first sever, and then split or pare. Its action is therefore a combination of the two previous methods.

With respect to the ordinary wood-turning lathe there is but little to be said. All builders of wood-working machinery make the head- and tail-stocks and rests, leaving the purchaser to furnish the shears, which are very often of wood, with wood or iron legs. Fig. 507 illustrates a typical form. For the convenience of pattern-makers

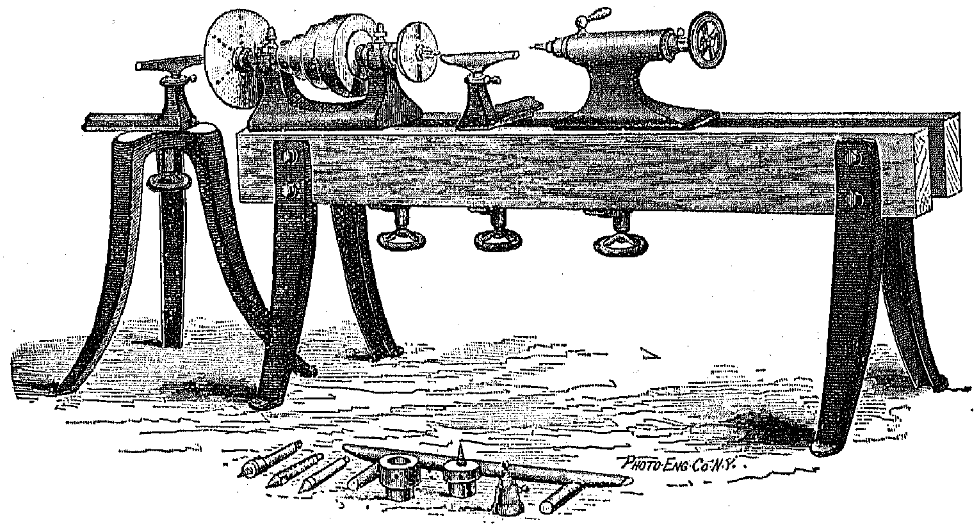

Fig. 507.

who may have large flat surfaces to chuck and turn the outer end of the head-spindle is made to accommodate a large face-plate, and a special tripod holds a second rest for facing large work. The lathe then has a swing equal to the height of its spindle from the floor. When the second rest is on the shears it may help carry the long double rest for long cylinders. The cone-pulleys are very often built up of mahogany for the sake of lightness at their high speed. The figure illustrates screw-clamps for tail-stock and rests. Very often lever cams or wedges are used. It also illustrates the prevailing arrangement of the nest of pulleys, with the largest nearest to the center. Fig. 508 shows an arrangement designed to give more freedom to the swing of long tools when working near the

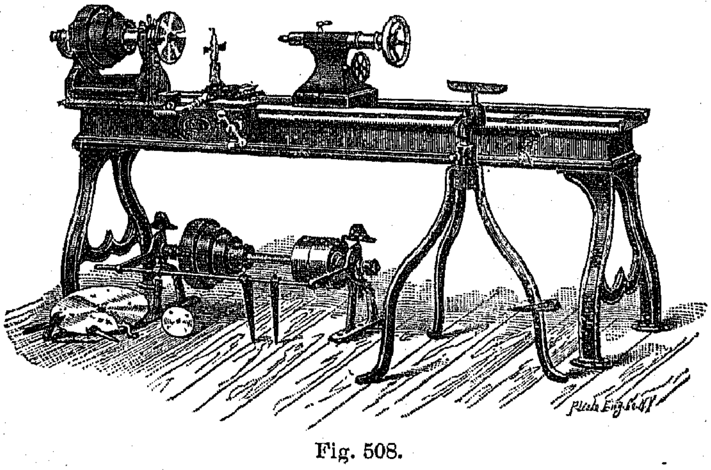

Fig. 508.

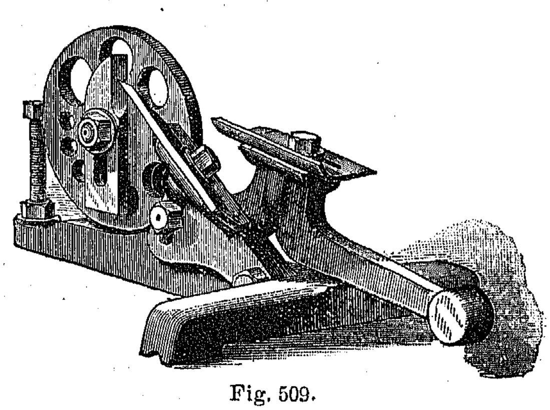

Fig. 509.

head. The cone is reversed, and has its largest pulley farthest from the center. This shows a type of iron bed, and the rest is moved along by rack and pinion. The T-rest may be replaced by a tool-holder, for dimension-turning of true cylinders. The shears have a flat top, and some builders make them solid across the top, with raised ways near the edges. The extra face-plate and tool-rest form part of this lathe also.

So simple is the wood-turning hand-lathe that it scarcely deserves further mention. Its large and varied capacities are due to the skill of the operator who manages it. But where a large number of duplicates are to be turned, a gauge-lathe will be employed. One man can attend to several machines, and all time for calibration and measurement is saved. The tool is held upon a carriage which receives its feed-motion parallel to the axis of the work. The position of the cutter-point is determined by a pattern or former on the lathe-shear. This former is fixed, and a pin or roller, moving over it, is compelled to vary the radii of the surface of revolution being turned. The tool-point is retracted or advanced as compelled by its connection with the pin at the pattern.

Fig. 509 shows a type of carriage to be run on a false shear on any lathe. The cutter is pivoted near the front end of its lever, and the knob on the rear passes over the corrugations of the pattern. The stock is kept from springing from the cut by the concentric disk, drilled with holes of varying diameter. The longitudinal feed may be given in any way, a very simple one being by a knife attached to the slide, which can be adjusted to take the stock at any inclination and generate any spiral or desired feeding speed. More usually these lathes are specially built, and have a screw-feed.

Fig. 510 shows how this may be applied in front of the shears, driven through an intermediate idle shaft with cone-pulleys from the driving-spindle. The feed is disengaged by clasp-nut at the end of a traverse, when the

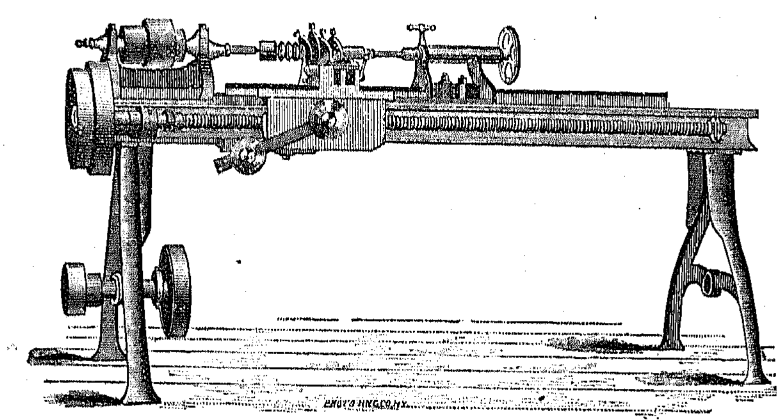

Fig. 510.

carriage strikes stops. The cut shows the use of several tools to distribute the strain of the cut and vary the finish. The pattern also in this lathe is central to the bed, so that no allowance has to be made for the differences in lever-arm of the guide and cutter. Where the pattern is at one side, the profile of its edge cannot be taken directly from the drawing of the finished work. A type of similar lathe, with devices to avoid stopping its motion, is shown by Fig. 511. The stock is guided centrally to the spur-center by the cone. The dead-center is brought up by

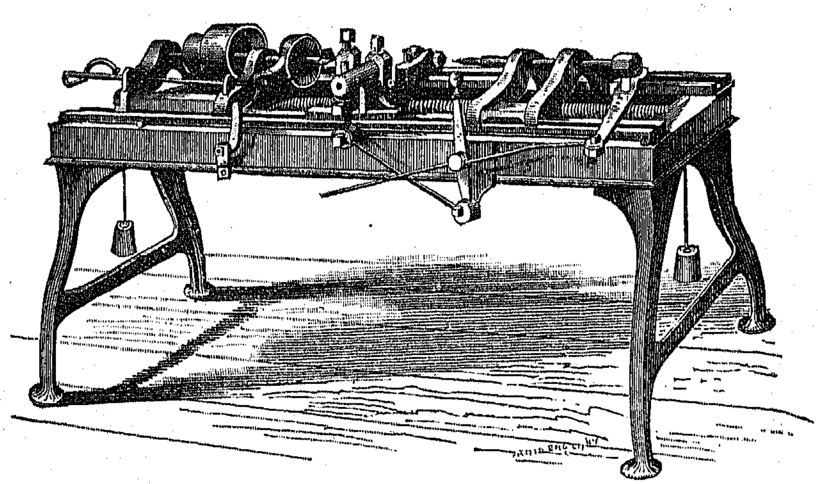

Fig. 511.

leverages and links, so as to save the stops and time required to get to it on long work. The feed-screw is between the shears. The larger and more elaborate gauge-lathes have a roughing-cut taken by a tool-point guided by a former, and finish the surface by the action of a knife which has the required profile.

Fig. 512 illustrates one of these. The carriage has a slide which fits the diagonal way planed upon the frame which holds the knife. The roughing-cut is made by the tool in the holder, guided by the former on the back shear. The knife is brought down behind the first cutter, and completes the work to a true profile. The knife, being set diagonally to the axis of the work, makes a progressive or dragging sort of cut, and cutting-off tools

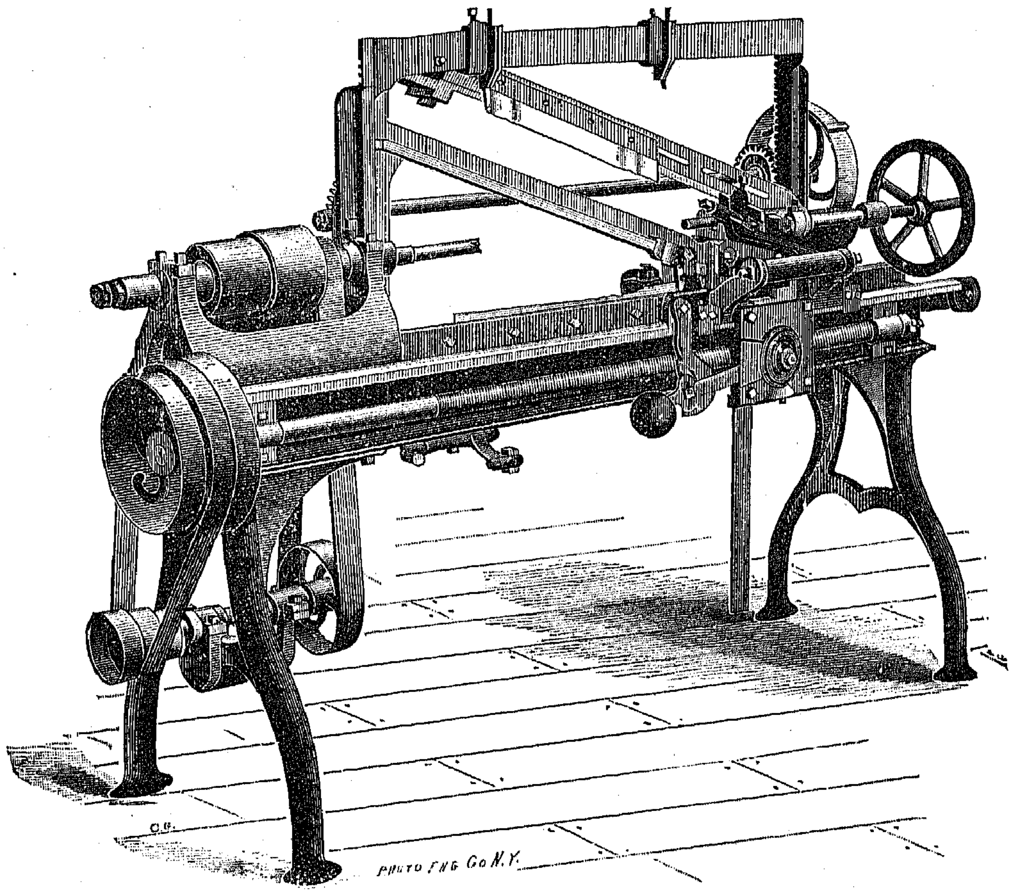

Fig. 512.

may sever the finished from the rough stock. The frame is equalized by racks, into which mesh pinions on the cross-shaft, which is counter-weighted. Stops release the feed, and a weight may draw the carriage back for a fresh piece. The design of Fig. 513 has the finishing-knife formed into a spiral, and brought down to the work by hand. The knife revolves around an axis, and the previous diagonal of a rectangle must become a helix. The

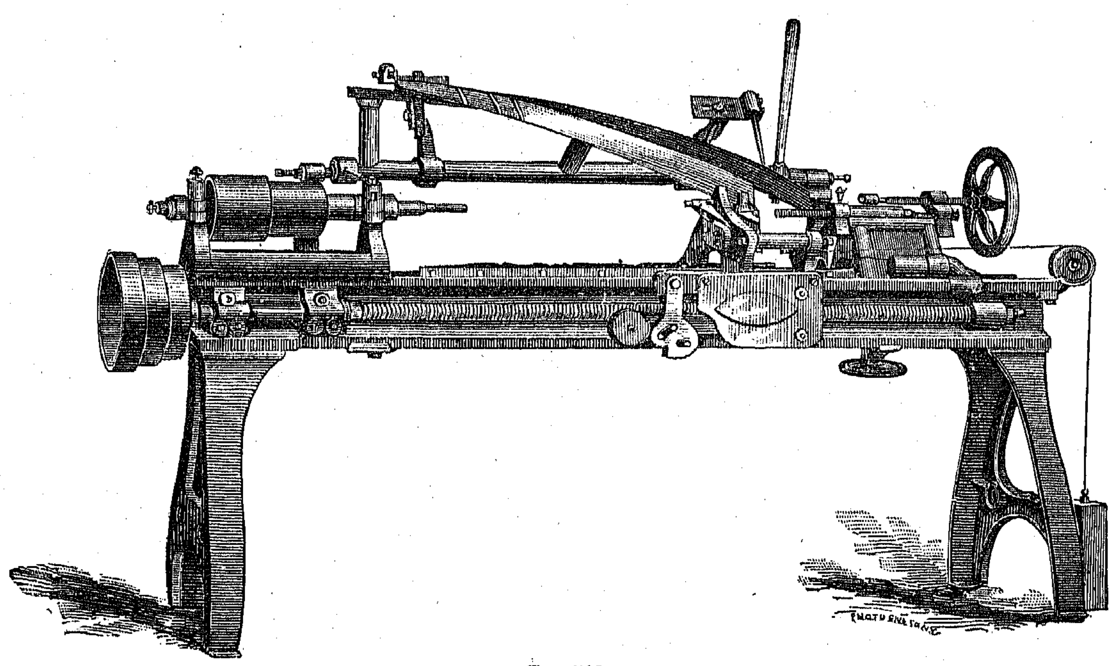

Fig. 513.

same progressive cut is insured, and a smooth, polished, or dead surface may be left, as desired by the operator. The centers of the knife-frame may be taken up for wear. In its other features it resembles the previous design. A ring center-rest, sized to the dimension of the largest part, is attached to the slide of long lathes for slender work. It is claimed for this second form that it is easier to handle in the case of breakage of half-finished work.

The gauge-lathe cannot be conveniently made to produce any but external surfaces of revolution. It is also unnecessarily heavy for a great deal of small work. The Waymouth lathe (Fig. 514) is designed to meet this

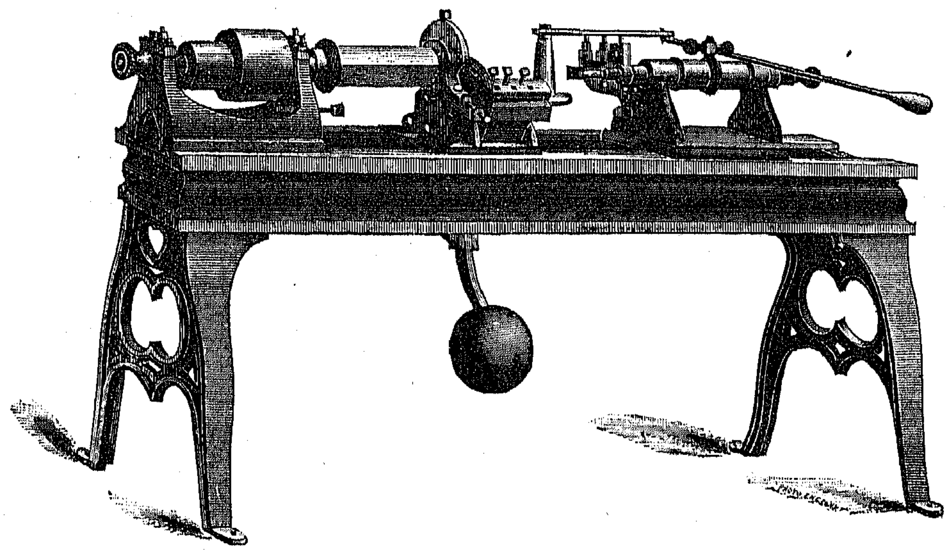

Fig. 514.

necessity, and will bore as well as turn. It is possible with such a lathe to turn 10,000 druggist's boxes in ten hours. The general principle is the successive presentation of properly shaped and located tools by the hand of the operator, or by his knee. These tools are fed up to stops laterally and longitudinally, and must therefore turn out work to standard size at every presentation. The stock is seized by an internal conical screw-chuck, which centers and rotates it. A tapering ring-tool on the carriage sizes and guides the stock, while the tool in the tail-

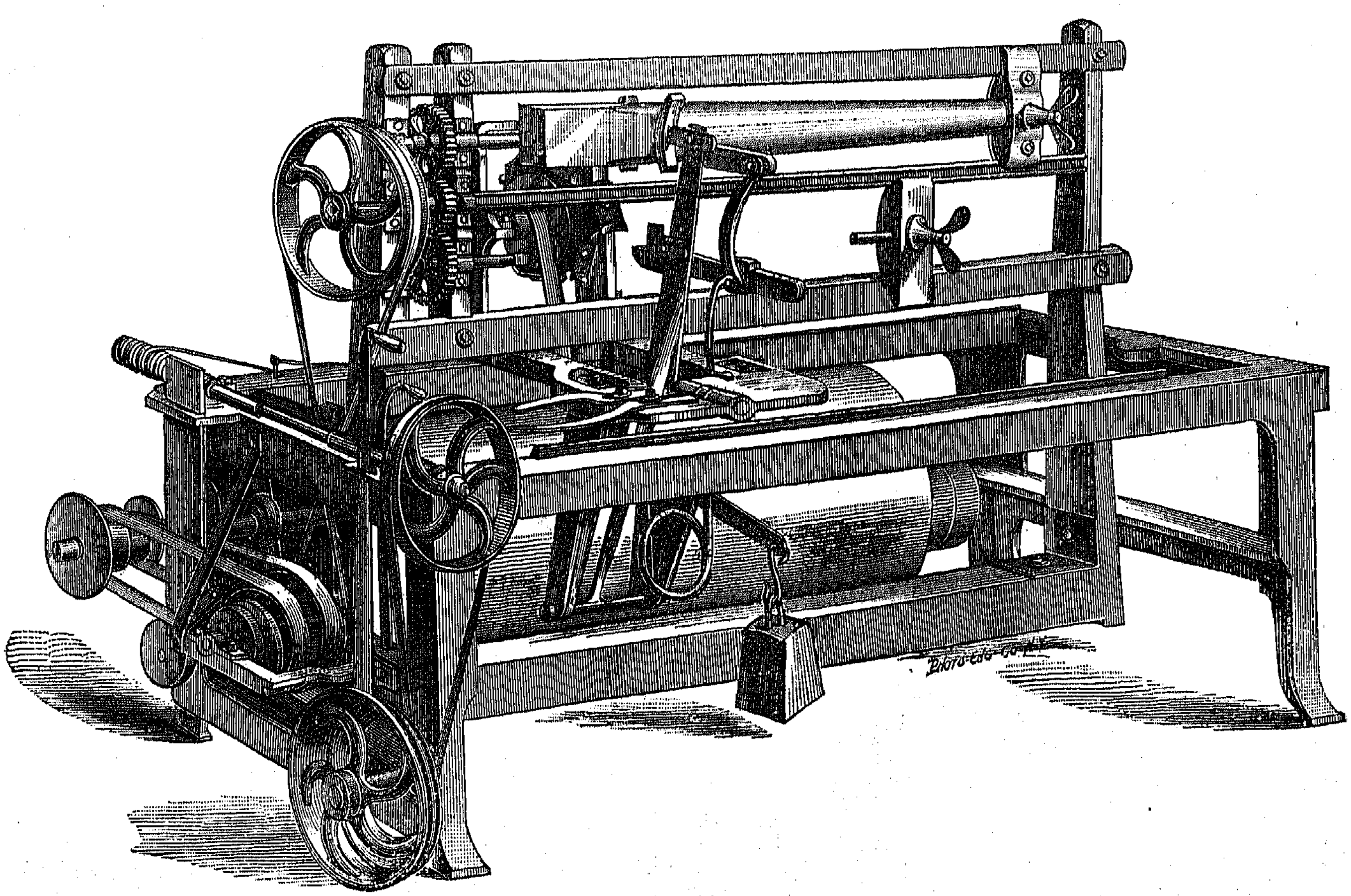

Fig. 515.

stock, fed forward by the hand-lever, acts on the end to do what may be there required. Behind the ring-tool is a holder for different special shaping tools. This holder swings toward the work around a hinge-joint near the foot of the carriage. The presentation of the holder is made by pressure of the knee upon the pad on the end of the lever. This lever turns a wrist-plate by a pin. A second wrist-pin throws forward the series of tools on the finishing-rest by a connecting-rod. This latter pin is so arranged that the tools in the holder can only be moved forward the required distance. Any further pressure retracts the tools, because the pin has passed its center. The circumference of the wrist-plate is toothed, and further pressure on the pad feeds up a cutting-off tool by a rack from below. The carriage and tail-stock are gibbed to the inside of the shears. This type of lathe is an exceedingly ingenious device for multiplying the capacities of the machine many fold. While hand-labor is retained to work the tools, yet the element of inaccuracy is eliminated, and all necessity for calibration disappears. Many classes of work could not be so well done by any other machine.

The term lathe might be restricted to those machines which produce volumes of revolution, as in the preceding examples. The name is often extended to cover a class of tools for the reduplication of irregular forms, such as gun-stocks, wheel-spokes, and handles for axes and picks. These are often called Blanchard lathes from the original patentee, whose patent dates from 1819. In their general features they consist of rotating cutters secured to a head. Some of them are roughing-cutters, and others for finishing. The former lead the latter, so that the work may be finished at one traverse of the cutter-head along the stock. The pattern and blank are borne in a frame pivoted below. This frame is controlled in its horizontal motion by an arm on the cutter-carriage bearing a friction-roller which rests against the pattern or former. The stock to be turned is held on centers parallel to the pattern, and the cutters are permitted to remove chips only so far inward as the pattern will permit. The pattern and the blank are slowly revolved, and the former is exactly reproduced. The older type of the lathe, which has advantages for certain duties, is shown by Fig. 515. The frame holding the pattern and blank is stationary endwise, and the carriage carrying the revolving cutters traverses along it. The long drum below drives the cutter-head, wherever it may be. The pattern is above the blank, and has to be larger, of course, than the finished article, which is centered nearer to the center of motion of the forming-lever. The blank and pattern are revolved at a speed of 60 or 80 turns per minute by the train of gears driven by belt from the cone-pulleys. The traverse of the carriage is effected by flexible connection, actuated by belt or by a worm device. The pressure upon the pattern and from the back-rest may be controlled by spring or by weight, or by both. The retreat of the frame at enlargements of the patterns is insured by the pressure on the front side. The feed is disengaged at the end of the traverse by the dogs on the carriage. In place of the wing-nut for adjusting the lower dead-center, a cam-lever may be used. The drum is sometimes mounted separate from the frame of the tool with advantage. Two hand-levers control the motion of the blank and the feed of the carriage and cutter-head.

Another form of the Blanchard lathe is shown by Fig. 516. The blank and pattern are centered upon uprights bolted solidly on a carriage, and the latter receives the traverse motion in front of the stationary cutter-frame. The

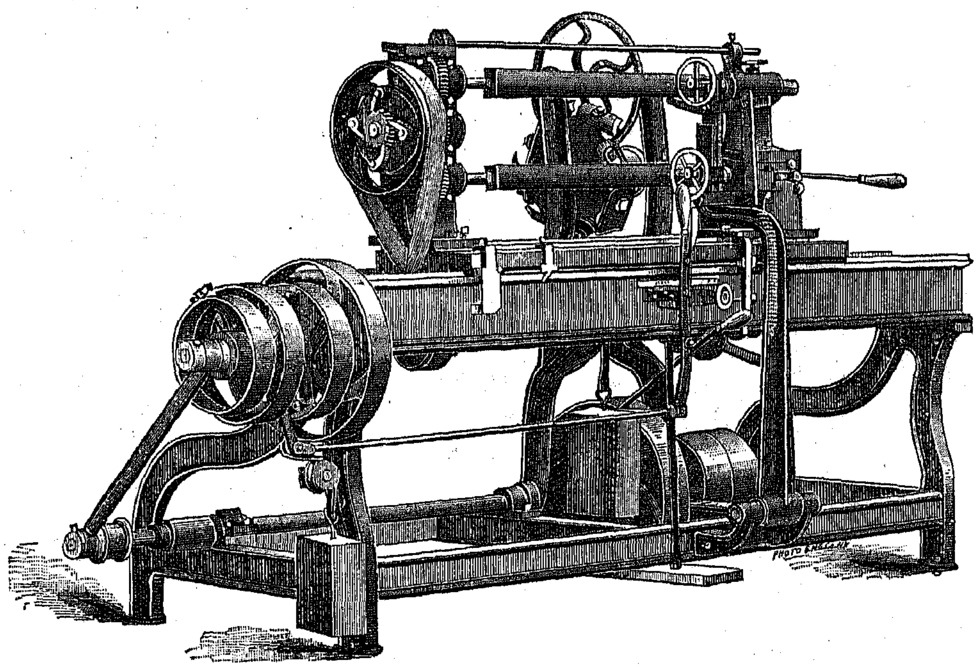

Fig. 516.

use of a long drum is thereby avoided. The yielding for variations of profile is given by the cutter-frame and not by that which holds the work. The cutter-frame is kept to its work by a weight, and a spring-back rest is provided to keep the blank from flexure. Dogs on the carriage disengage the feed at the ends of the traverse. The wheel which turns the blank and pattern is connected to the gears by ratchet and pawls. The inconvenience of revolving the blank when running backward is thus avoided.

Fig. 517 shows a lathe with drum overhead and traveling cutter-carriage. The latter moves on rollers, and is made heavy to resist the jar of the cutter-head, which revolves at 8,000 feet per minute at the circumference.

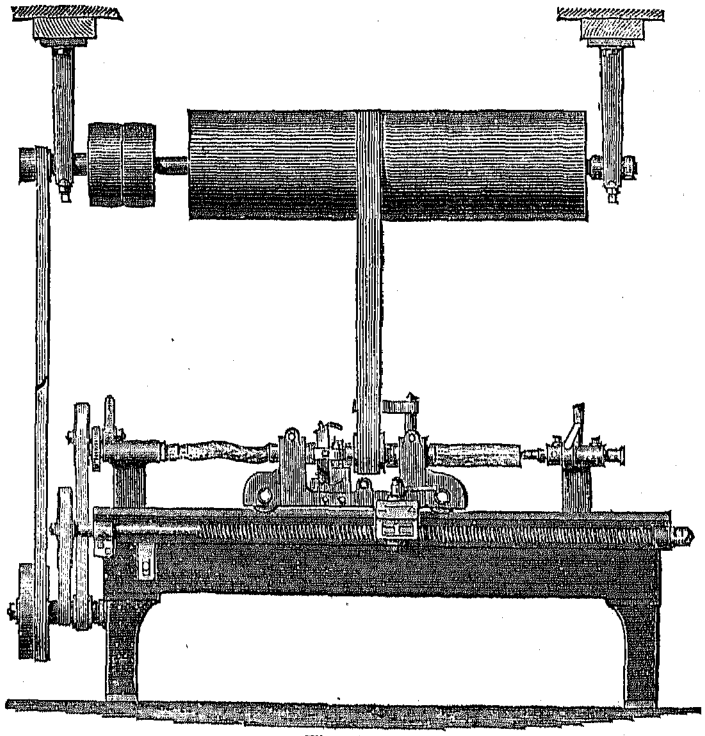

Fig. 517.

The feed is by the bed-screw, and is made variable by change-pulleys at the head. The pattern lies in the same plane as the blank, of which it is an exact duplicate. The same feature of exact duplication of form is obtained by the design of Fig. 518. The cutter-frame is fixed, and the holders turn on an axis as in the preceding design. The rotation of the blanks is given from the drum at the back, and the carrier-frame traverses horizontally. The

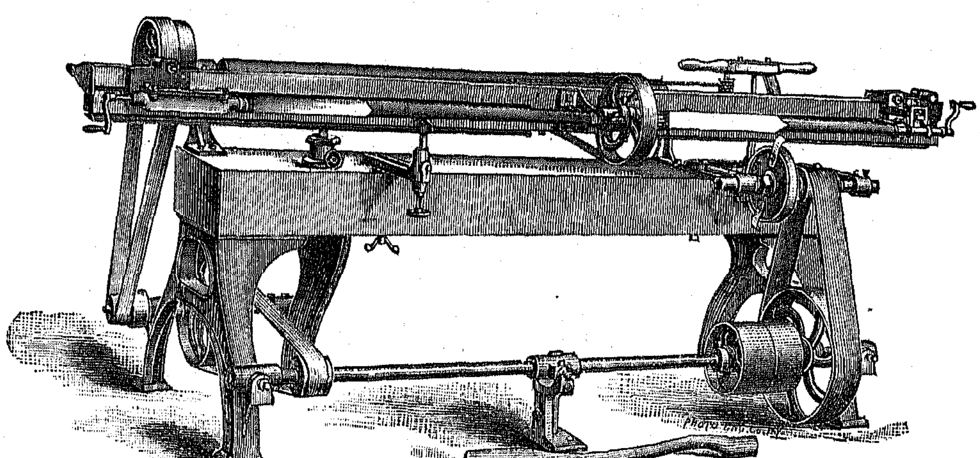

Fig. 518.

tilting carrier-frame is adjustable vertically for different diameters of work. The stops are automatic, as are the feed-motions. Saws may be used instead of cutter-heads if better adapted for the wood or the shape. These tools have been so long and so well known that extended reference to their capabilities would be superfluous. The improvements of latter years have been in details of construction to keep pace with the march of mechanical progress.

Akin to the action of lathes (although inverted) is the action of rod, pin, or dowel machines, such as Fig. 519 *a*. The stock is fed in by hand, and is shaped by the revolving knives. The slope of the knives draws the work inward toward the cutter.

Fig. 519 *b* shows a chuck or holder for steadying the work, and preventing it from turning in the hands of the operator. The machine is exceedingly simple, and is of very great service in many shops. Power-feed machines upon standards are also made.

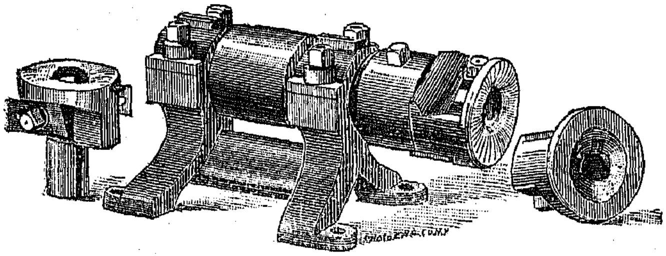

Fig. 519 *a*.

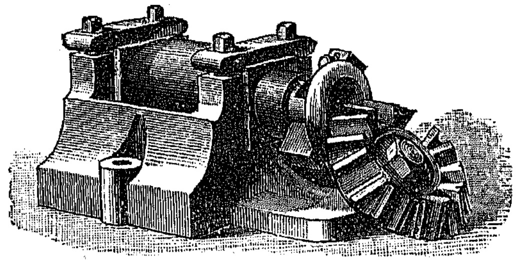

Fig. 519 *b*.

Akin also to the lathes in their action on the lumber are the spiral veneer-cutting machines of which Fig. 520 is a type. The log revolves slowly in front of a stationary knife, which advances by the thickness of the sheet at each revolution. All loss from dust and saw-kerf is thus avoided.

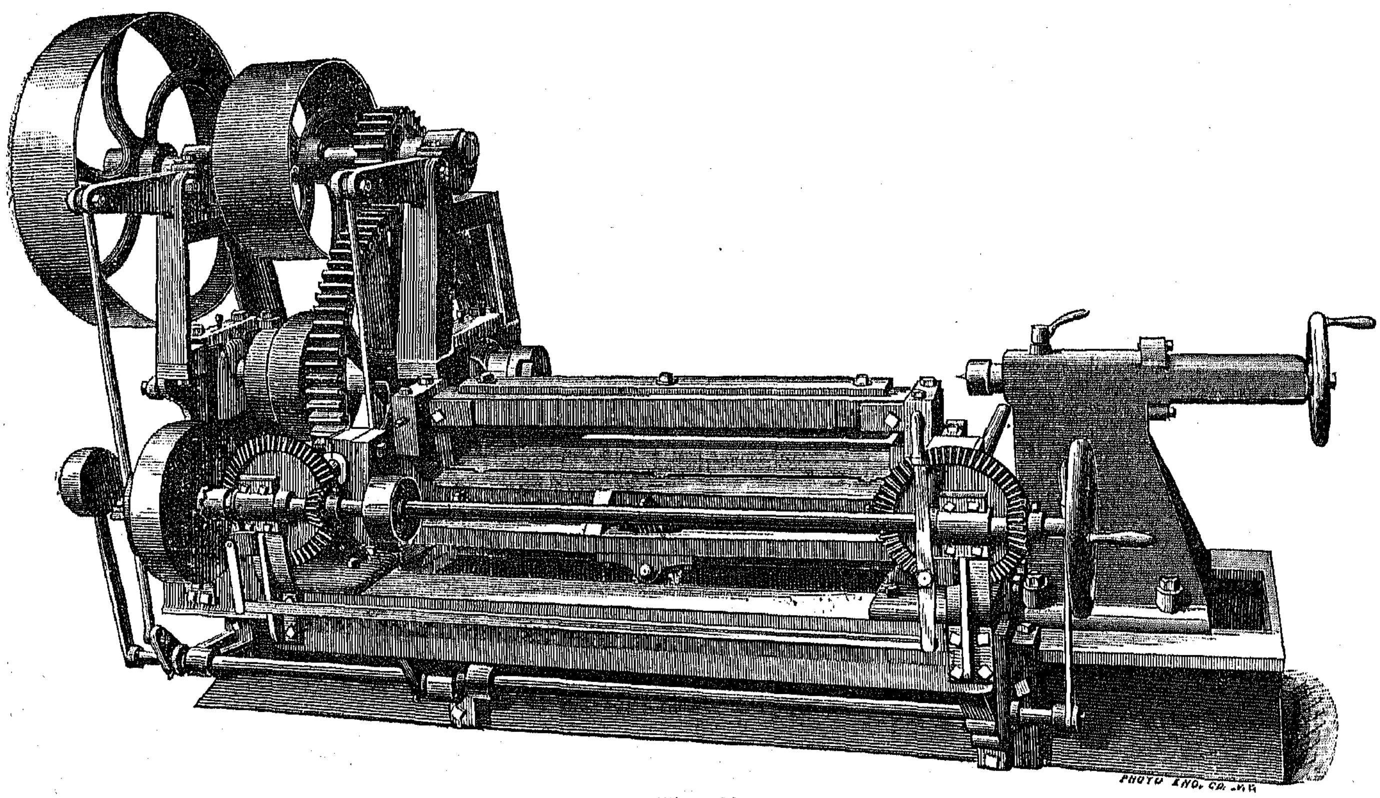

Fig. 520.

§ 52.

TENONING-MACHINES—GAINING-MACHINES.

The joint by tenon and mortise is of primary importance in wooden constructions. Machines for making the parts of the joint will be of wide application in car, carriage, pattern, and bridge shops. The tenon is made upon the end of the piece. A rotating cutter will, therefore, sever the fibers and split them off for the required distance. The severing of the fibers will be done either by sections of saw-plate, or by spurs on the chisel edges of the paring-cutters. The cutters are often arranged spirally, so as to produce a dragging cut, and more in the direction of the fibers. The work is fed to the cutters in the smaller and medium sizes; in the larger designs the cutters may move toward the lumber. This latter arrangement is specially applicable to the machines for double tenons.

In the series of designs of which Fig. 521 is a type, the framing is mostly of wood, with some parts of iron. The lower head is stationary. The height of the lower shoulder is varied by raising or lowering the carriage-ways by the inclined planes operated by the hand-crank. The thickness of the tenon is varied by the rise and fall of the upper cross-frame, which is pivoted at the upright at the rear. The tilt of this frame is controlled by the screw-and hand-crank in front. The bearings of the upper cutter are adjustable longitudinally to permit the upper shoulder to be offset from the line of the lower, if desired. The two cutter-heads revolve in opposite directions so as not to tend to twist the stock. This latter is held and steadied on the carriage by the foot upon the adjustable hand-lever. But one belt is used. It passes from the driving-pulley below up over the upper head, thence down

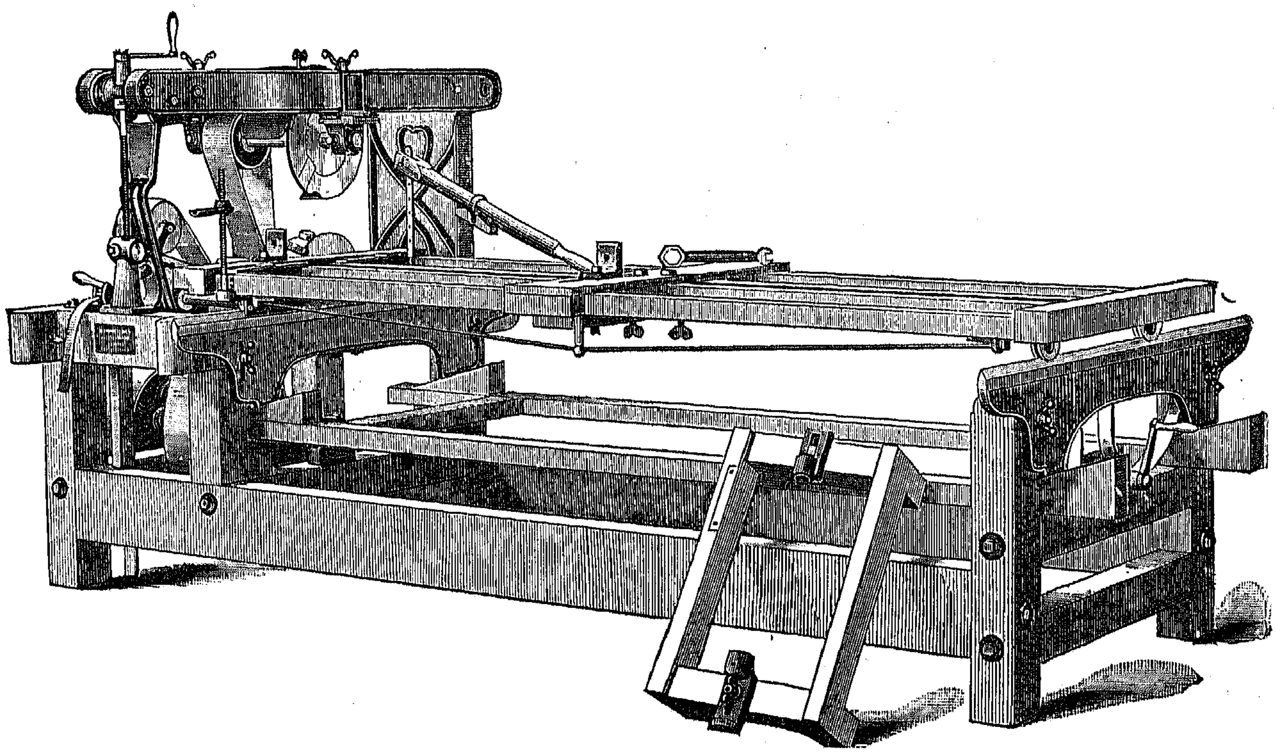

Fig. 521.

under the lower head and upward over a tightener and guide-pulley to complete the circuit to the driving-pulley below again. By this means the cutter-pulleys have the belt around half their circumference, and variation in the thickness of tenon is compensated for. In the form shown the tightener is on an upright, and a flexible thong is clamped to maintain the due tension. Fig. 522 shows a wood-frame machine, with the addition of cope-heads for

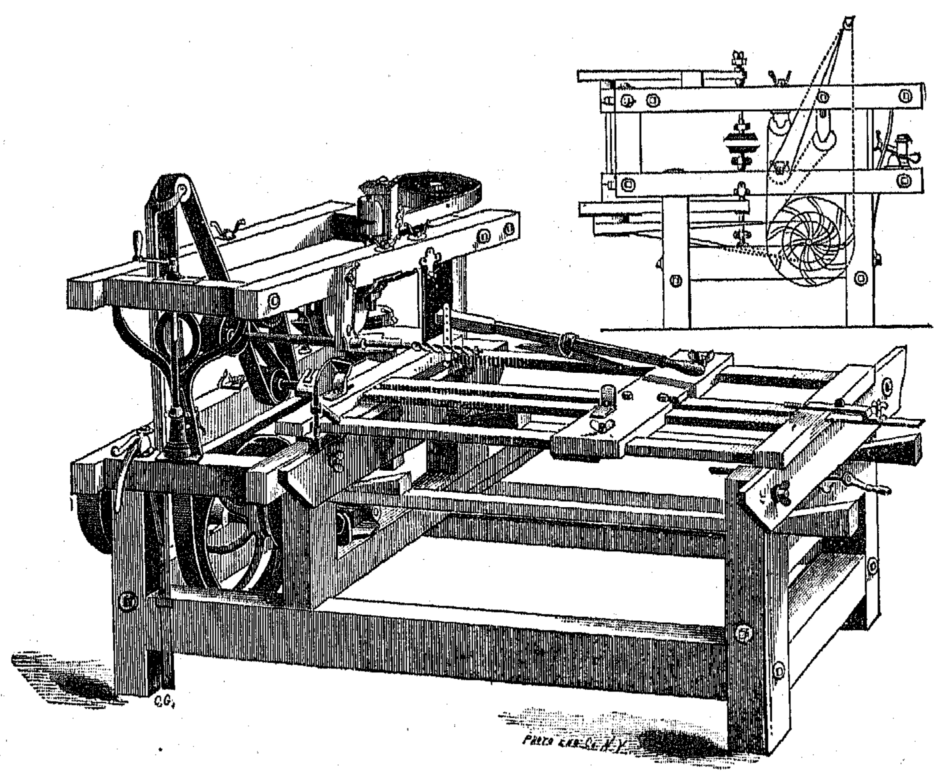

Fig. 522.

profiling the shoulders of the tenon. They are on vertical axes, as shown in the skeleton front view, driven from a counter-shaft at the end. The tightener-pulley stands higher, strained in the same way, and an adjustable boring attachment may be applied, if desired. The cope counter-shaft is driven by a quarter-twist belt from the lower shaft. The design of Fig. 523 illustrates a type of framing partly of iron and partly of wood. The table guiding the carriage has no adjustment, since all required motions are given to the cutter-heads. The frame carrying the lower head is raised and lowered, for the variation in lower shoulder, by a screw turned by the larger hand-wheel. The

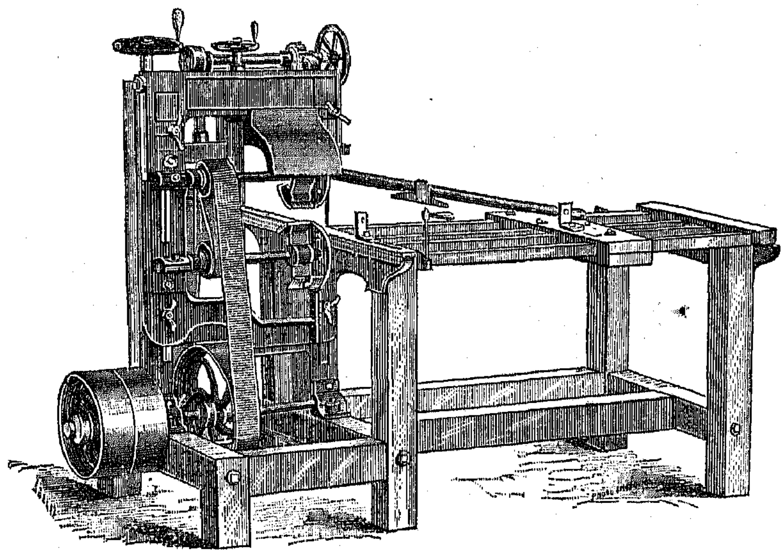

Fig. 523.

frame of the upper cutter is faced to the frame of the lower, and adjusts to the latter by the smaller hand-wheel. By this method both cutter-heads may be moved up or down without changing their relative positions to each other. The shoulders may be varied, therefore, without change in the tenon, or the tenon may be changed without altering

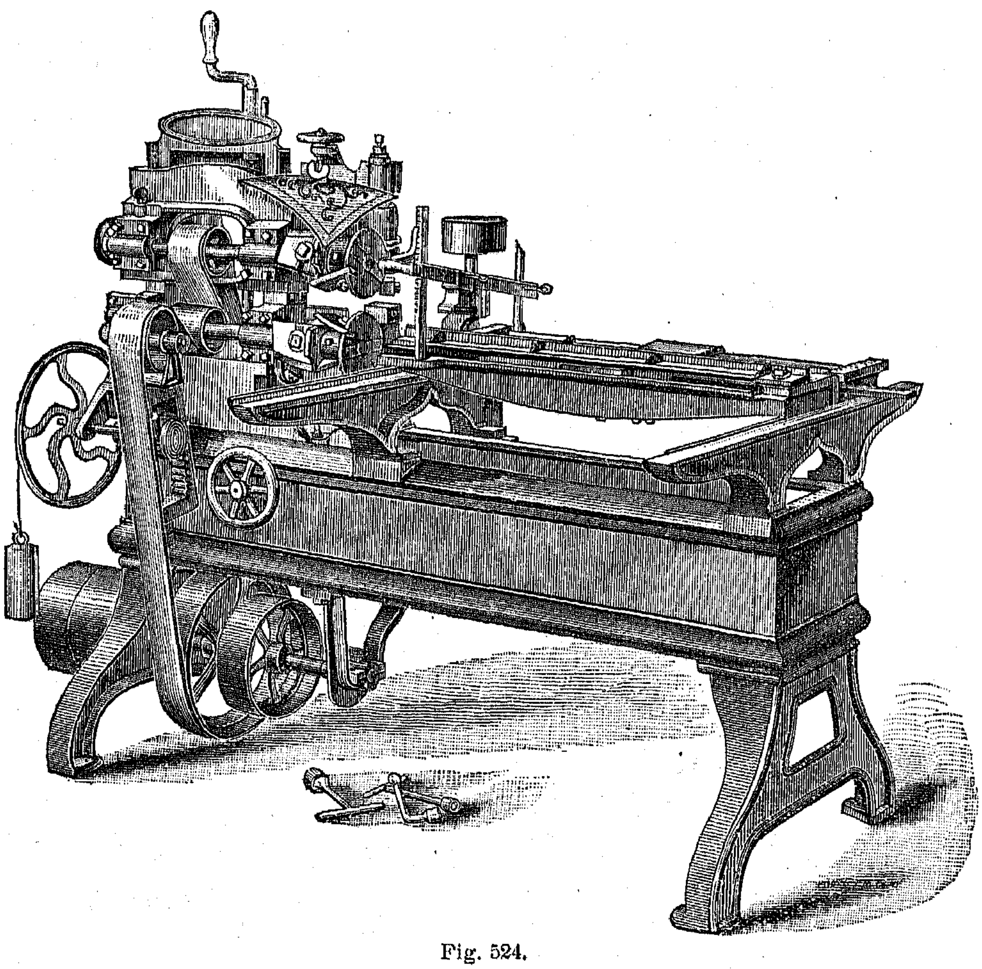

Fig. 524.

the lower shoulder. The upper boxes may be moved to offset the shoulders. The tightener is adjusted by a ratchet and pawl shaft turned by the hand-wheel. The front string piece on the table is of iron, guiding the end next the cutters and permitting increased depth of shoulder to be cut on the lumber.

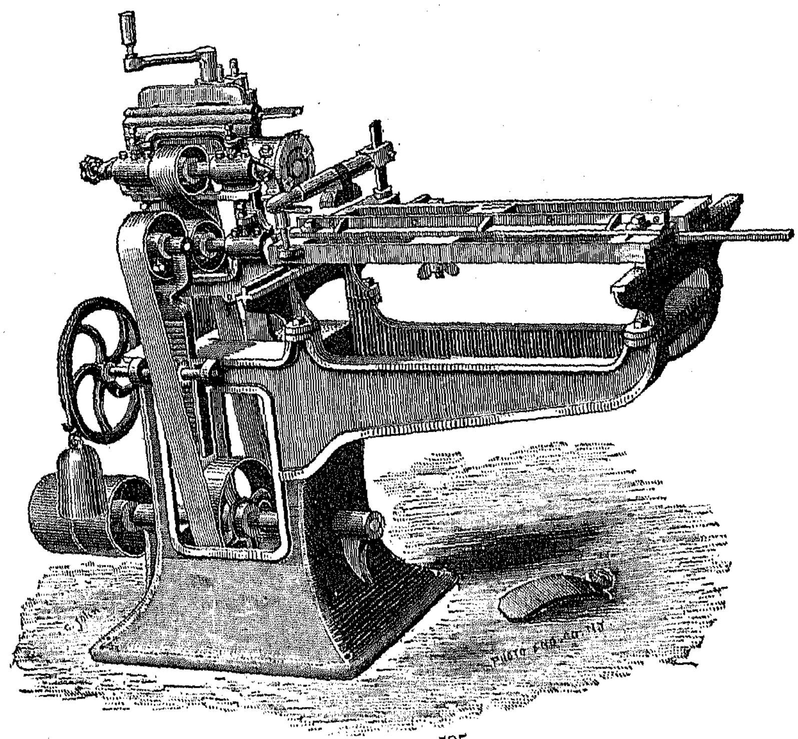

Fig. 525.

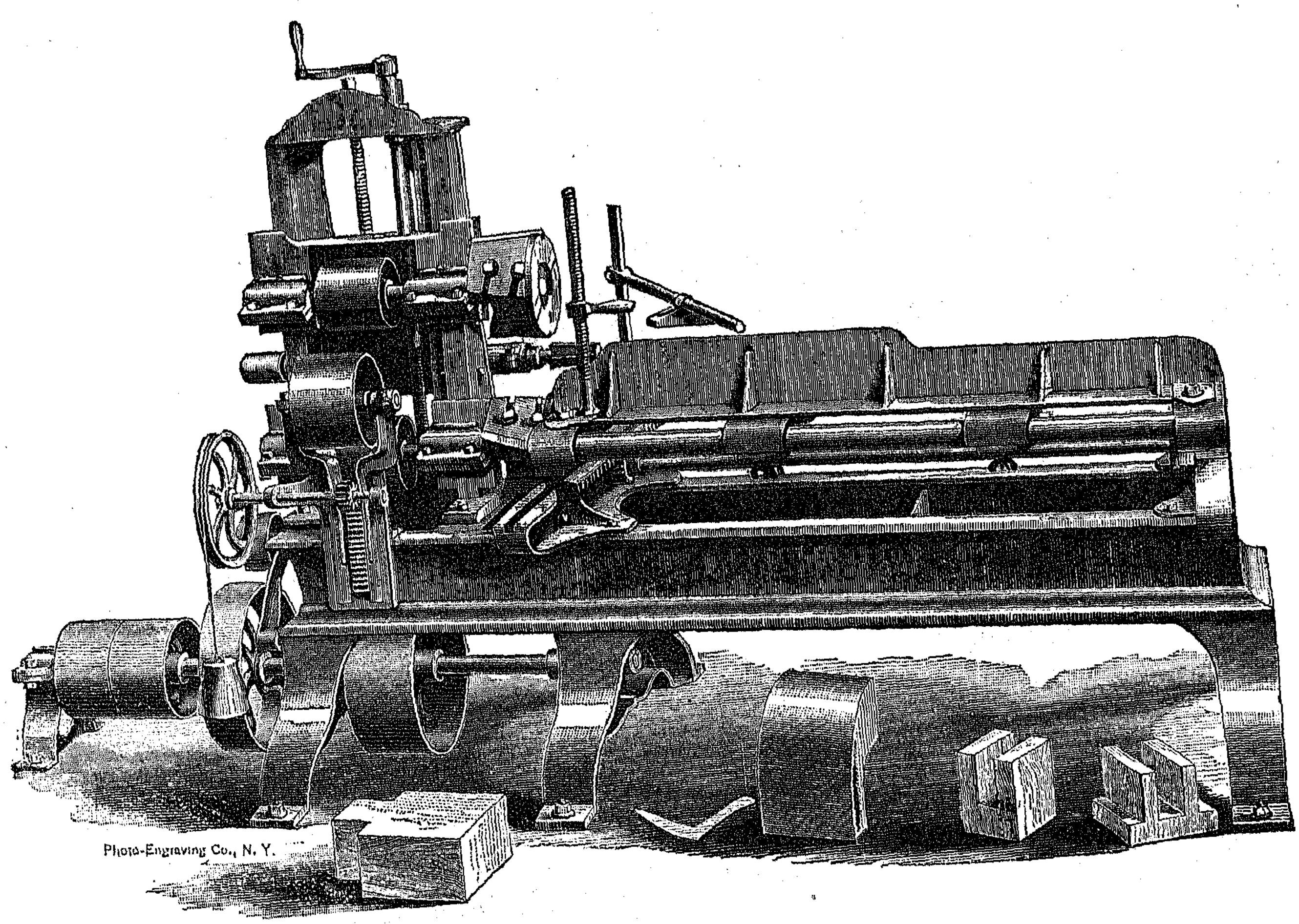

Fig. 526.

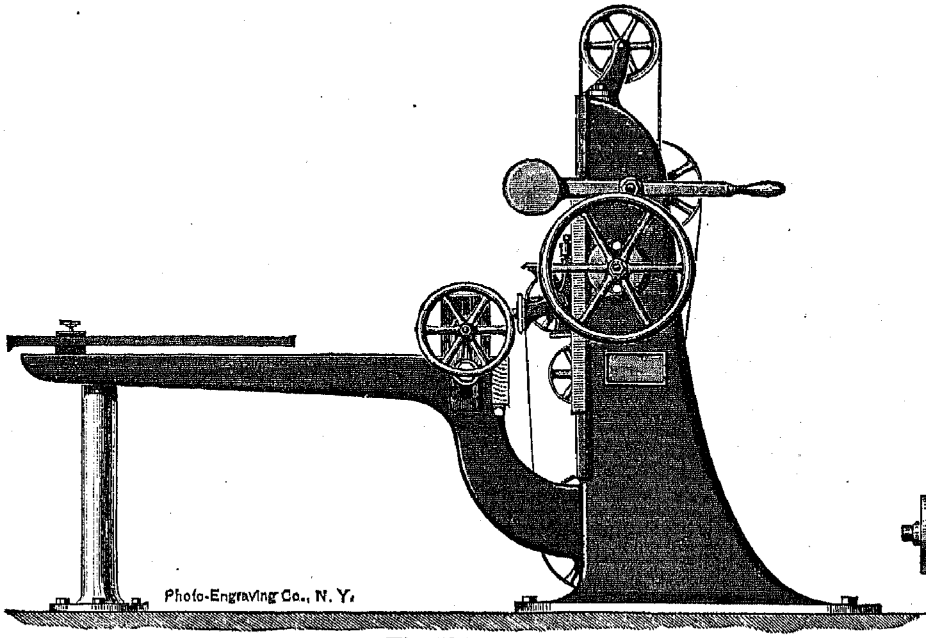

Fig. 527 *a*.

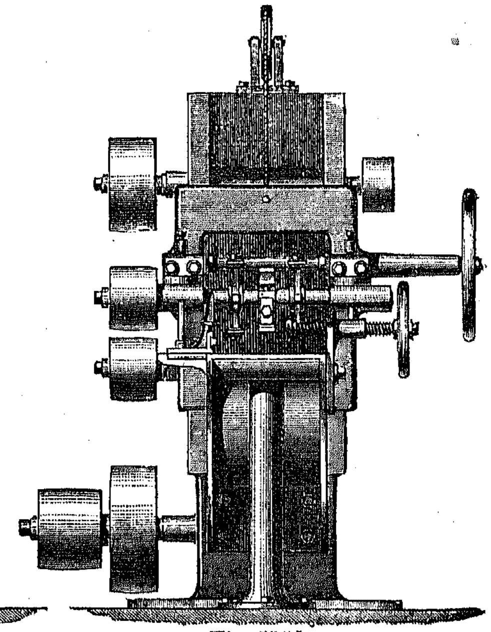

Fig. 527 *b*.

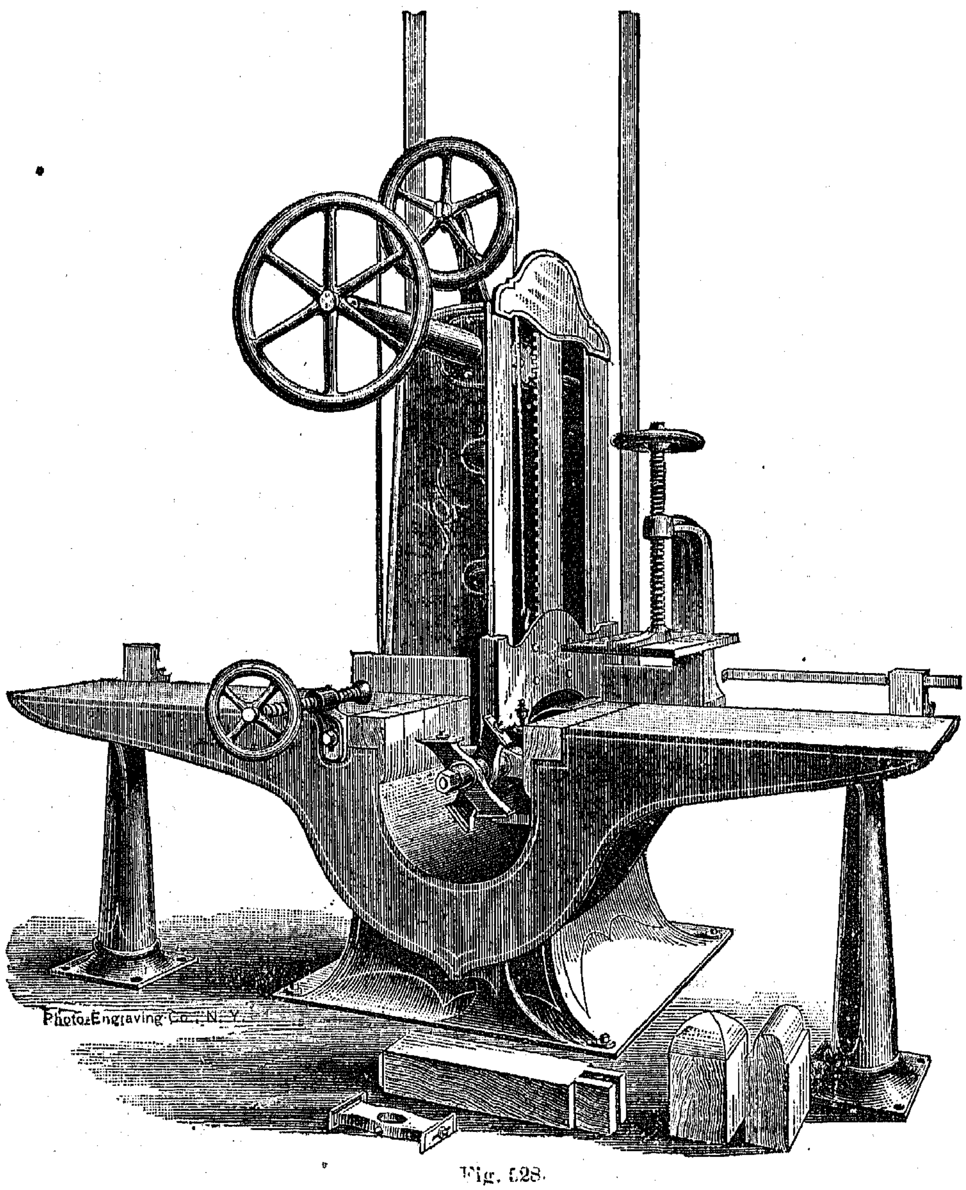

Fig. 528.

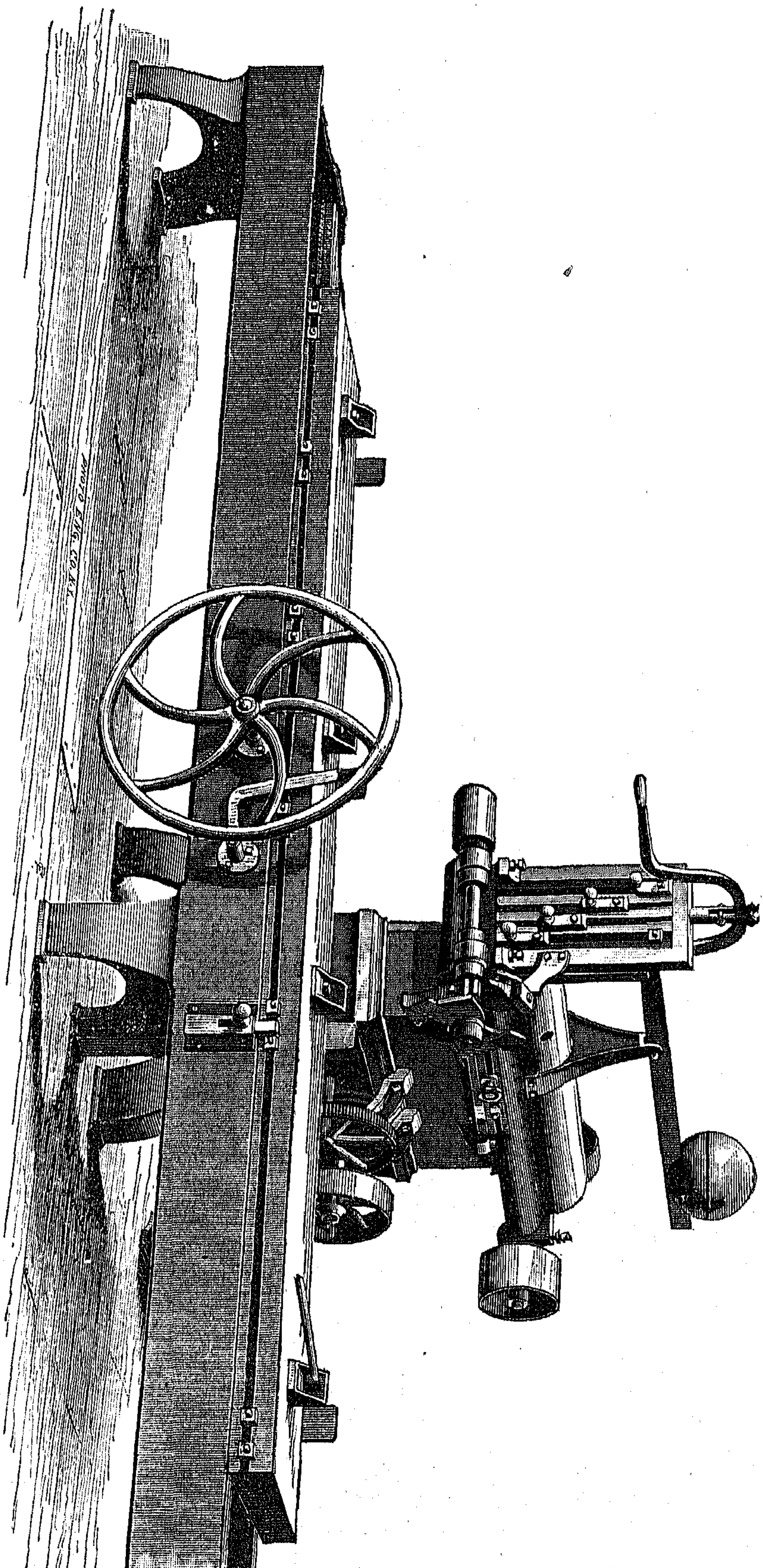

Fig. 529.

Fig. 524 shows the average size of iron-frame machine, with adjustment of the heads upon slides. The binder-pulley is counter-weighted in the simple manner which is usual in the newer tools. The holder of the roller has a rack cut on it. On the axis of a pinion which meshes into it is a larger grooved wheel, round whose circumference is wound a wire rope sustaining a weight. By the gain of leverage a light weight is competent to strain the belt.

Fig. 525 shows a new standard machine for cabinet- and spoke-work. While the cutters on the sizes hitherto have been known as 8-inch heads, those on this machine are but 5 inches, so that higher speed may produce smooth work. The especial feature of this design is the use of gibs under the slides of the table, so that by no possible overweighting or lack of balance can the table be thrown into the cutter-heads. The adjusting-screws for the heads are conveniently geared so that they may be moved together or separately. The upper spindle-boxes move in dovetail slides by the hand-wheel at the tail for offsetting the shoulders. The machine of Fig. 526 is the size adapted for car and other heavy work. The two ends of the long table are compelled to move together without binding on the ways by pinions on a shaft, which mesh into racks under the ways. These also prevent the table

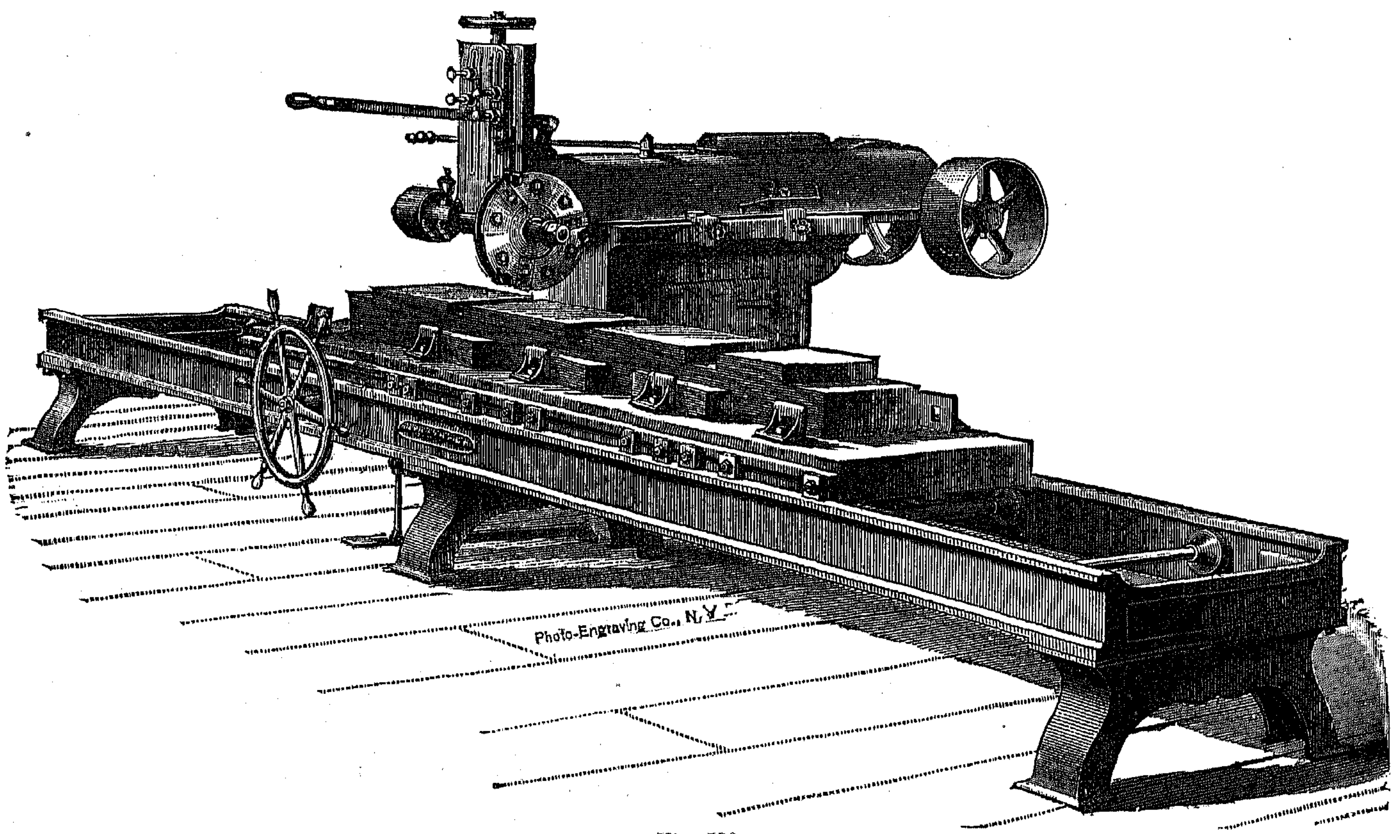

Fig. 530.

from tilting. On the rear of the standard is a third removable head acting like a rotary mortiser to make double tenons, as in the sample at the foot of the machine. This small head is driven by a separate belt outside of the head. The method of adjusting the heads is very obvious, as also the shape of the cutters for a dragging cut. It is more usual, however, where multiple tenons are to be cut to change the system of design, and to have the cutters on an axis at right angles to the axis of the timber. Moreover, as the timber usually is very large and heavy, when multiple tenons are desirable, the cutters are made to traverse across the work which is held stationary.

Figs. 527 *a* and *b* show one form of this type of machine. The work is presented from the front of the machine The cutter-axis is borne on a counter-weighted slide which is moved up and down by the large hand-wheel. The belt passes from the shaft at the base over the cutter-pulley, and thence under and in front of a guide-pulley on the slide. From underneath this it passes over the upper pulley and so back to the driver below. The driving is thereby with constant tension on the belt.

Fig. 528 shows a type of multiple tenoner, by which both ends of a long timber may be tenoned from one face without turning it round. The action is the same as in the preceding designs. The timber is clamped upon the table and finished at one end by lifting the slide, and is then slid over the gap and is tenoned at the other end on the descent of the cutters. End-molding or shaping-cutters may replace the tenoning-heads for certain duties. The clamping devices may be doubled on each side of the gap, with the counter-shaft on the floor at the side. In Fig. 528 the counter-shaft is overhead, and the clamps are single. To prevent splitting and fraying at the lower edge the lip of the gap of the latter is faced with wood, to which the cutters come very close. Gauges are easily attached for standard lengths upon the tables. Such machines as these will operate on heavy work as fast as it can be presented to them. They possess marked advantages over the machines with similar functions in which the axis of the cutter is vertical and receives a horizontal traverse. This latter arrangement is not in use in this country. It is, of course, a simple operation to make any tenoning-machine cut the shoulders oblique to the long axis of the timber. It is only necessary to make the obvious change in the plane of the table or fence. Any extra-long work can also be done by the use of double sets of cutters.

Closely akin to the tenoners of the previous class are the tools which are called gaining-machines. A gain is a groove cut across the grain of a timber, usually at right angles to its length. The gaining-cutter will, therefore, require spurs or saw-segments at both sides, instead of upon one only. The gain and the tenon may be of the same depth and length in work of given dimensions. But the gain is not at the ends, nor usually near them, and hence a special class of tool is made to produce them. The general type of machine is shown by Figs. 529 and 530. The cutter-axis is driven from the pulley at the rear. Both are borne upon the long gibbed slide, which moves forward across the table and causes the cutters to plow the gain. The shaft at the rear receives its motion from a counter overhead, which stands over the middle point of the traverse of the pulley. The motion backward and forward is effected by a train of gear, which drives a pinion meshing into a rack on the under side of the slide. Adjustable stops make the reciprocation and the arrest of motion when the slide is back to be entirely automatic, but a hand-lever may operate these devices at any time. Power for the traversing is obtained by belt from the counter to the pulley at the side of the base. Both forward and back traverse may be at the same speed, and the cutter may act on both motions as in the vertical tenoner. The cutter-axis is borne on a vertical slide, by which the depth of the gains may be varied. Stops may be fastened to the rear plate, and these may serve to arrest the downward motion of the front slide at any depth or at any series of depths. Gains of different depths may be sunk in the work by using different stops in the four slots of the face. Any of the stops may be made inoperative at will by pulling out a pin in its center. No readjustment is required when the stop is to be used again. The pushing in of the pin of any one stop causes it to serve. The weight of the slide is borne either by a counter-weight on the hand-lever, or by a series of springs in the back-plate. The stuff to be gained rests on a carriage, to which it is secured by wedging it against knee-blocks. The table moves on friction-rollers, and is guided by ways. It is moved by rack and pinion from the large hand-wheel in front. In front of the carriage or table is a T-slot, by which a series of dogs or chocks may be secured. In the path of their motion is a projecting pin, which may be pulled out of the way by treadle or handle, but which returns to its place by a spring. These stops may be spaced so as to produce standard spaces or widths of gain in series of duplicates, without loss of time for measurement. Their function is identical with that of the stops on the vertical slide, and add immensely to the capacity of the machines.

In the design of Figs. 531 *a* and *b*, the long slide has a quick-return. The vertical lever which projects up through a slot in the slide is pivoted upon the center just under the ways. The arm which hangs downward from

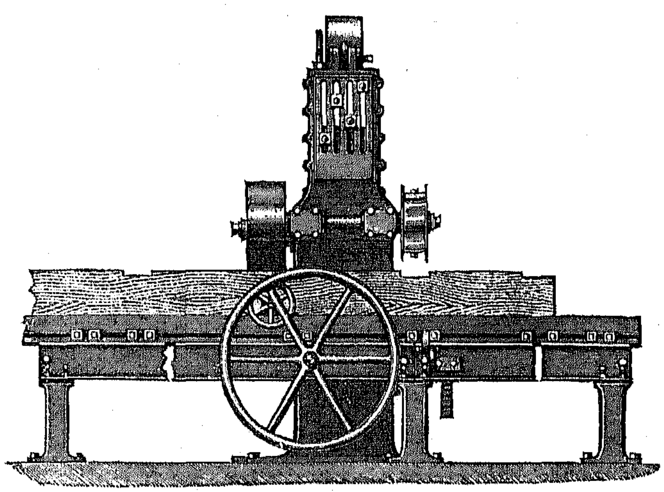

Fig. 531 *a*.

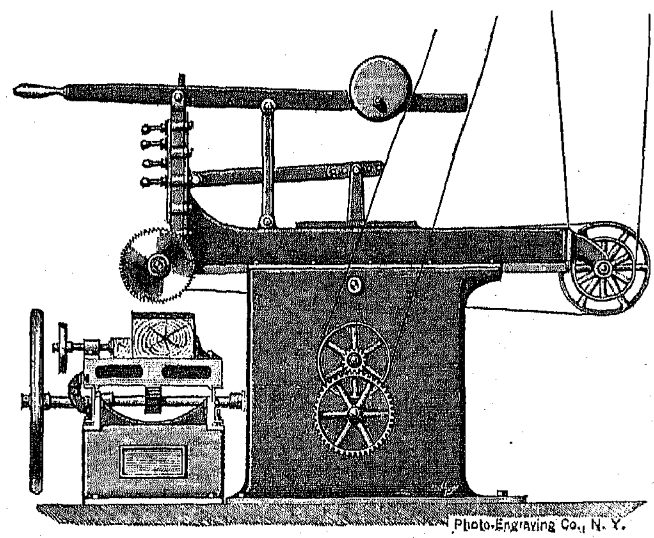

Fig. 531 *b*.

this center carries a slot into which is fitted a crank upon the axis of the larger lower gear. It will be seen that when the crank is down it acts to move the slide forward slowly with long leverage. When the crank is up it acts nearer to the center of motion, and brings the slide back rapidly. The horizontal link has several holes to enable the slide to overhang more or less. In this design a full saw is used on each side of the paring-cutters. Segments of saw-plate are more usual.

Fig. 532 shows the ordinary form of groover-head as used for sash- and door-work. The cutters have spurs, and are held in place by taper compression-bolts.

Fig. 533 shows a type of expanding-head for gaining-machines. The cutters are compressed by bolts in slots,

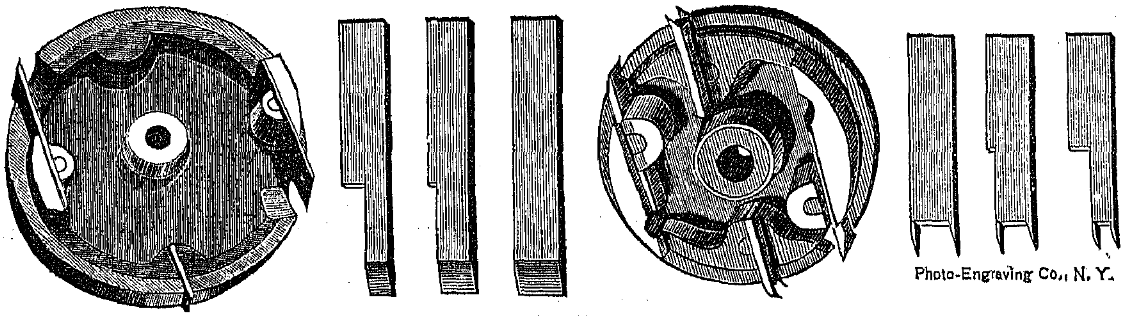

Fig. 532.

and, by changing the chisels, the widths of the gains may be varied. Different types of expanding-heads are used for various purposes, such as dado work, for example, differing with the method of mounting (Figs. 534 and 535).

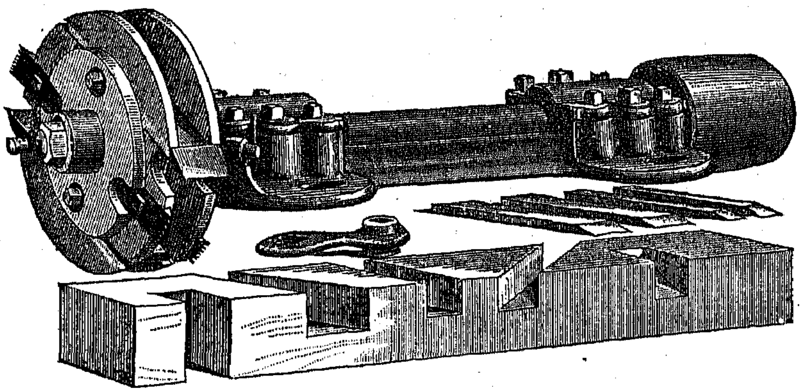

Fig. 533.

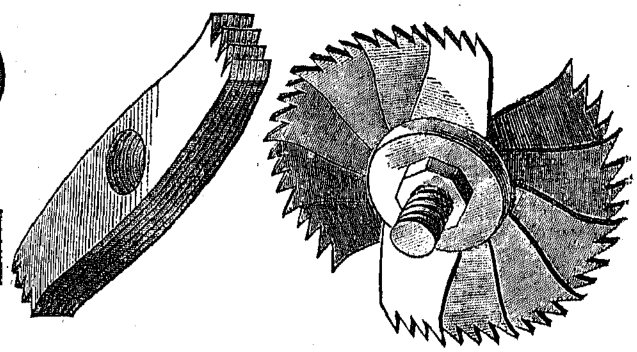

Fig. 534.

A reference to tenoning-machines would be incomplete if it did not embrace the machines for special tenoning, such as are required in blinds and wheel-spokes. The slat of the blind, having been shaped upon a sticker, is held in a chuck, and revolved while it is presented to the cutter. The tenon is made round by the rotation, and the end does not split or fray.

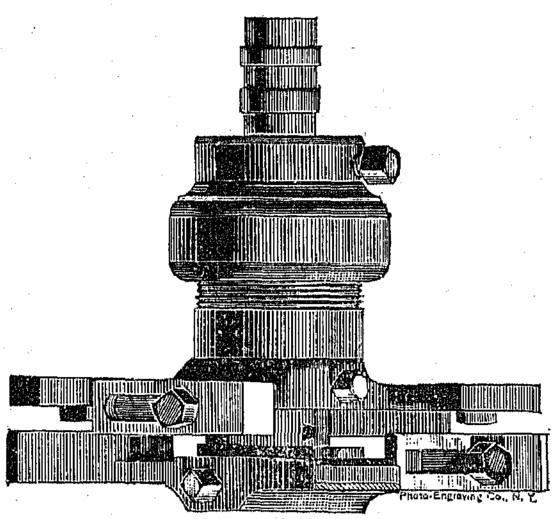

Fig. 535.

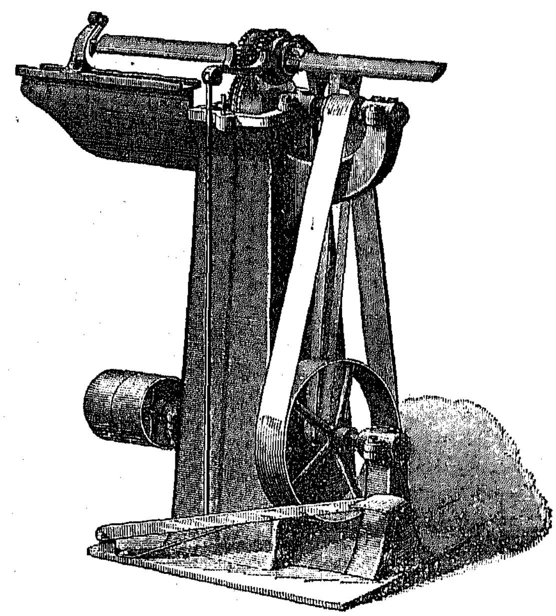

Fig. 536.

Fig. 536 shows a form of machine embodying the features of the Ellis & Bickford patents, which divides the slat and cuts two tenons in the middle. In the Ellis machine the tenons are cut at each end of the slat by two cutters.

Fig. 537 illustrates an oval tenoning-machine as applied to wheel-work. The wheel is chucked on its hub, and a small circular saw cuts all spokes to the same length. The spoke which is operated on is held by geared centering-clamps, which bring the center of a spoke of any size to the center of the revolving disks. The upper part of the machine which carries the cutter-heads has two disks, which are revolved by a series of cut gearing, governed by a lever for the foot, which acts upon friction-pulleys and is under the control of the operator. The

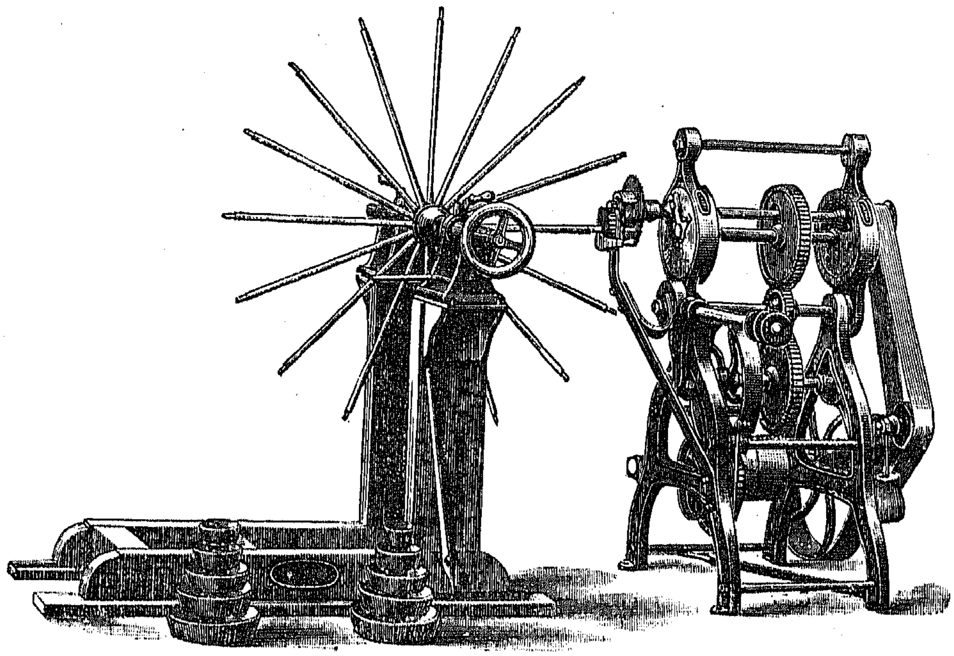

Fig. 537.

arbor on which the cutter-head and saw are secured passes through the revolving disks near their peripheries, the boxes in which it runs being secured to the disks, but they are adjustable by means of cams for the different tenons. The upper part of the machine in which the disks revolve has a vibrating motion given to it by the weighted hand-lever. By depressing this lever the cutter-head is brought forward and cuts the oval, which may be varied in size to suit the work required. The oval tenon reduces the danger of splitting the felloes, and may render wedging unnecessary. Wheel-making may also use machines for truing spoke-tenons, for bevel-facing, shaping and throating the hub-ends of spokes, or for making the simple round tenons used on ordinary spokes. Most of these, however, become special machines, applicable for one industry only.

§ 53.

MORTISING-MACHINES—ROUTING-MACHINES.

The mortise receives the projecting tenon. The cutter must produce a cavity in the solid part of the timber, and must act first to cut the fibers, and then to pare away the chips. Mortising-machines are of two general classes. The first includes those which act by rotating cutters, which cut both upon sides and end. The second class includes those which act by a reciprocating chisel. This latter class has several varieties. The principle of the rotary mortisers is found in the panel-sinkers and bracket-molding or carving-machines.

In a machine for small work, such as the chair and blind industries, the rotating arbor is pivoted at the rear, and receives a vibratory motion from a slower moving wrist-plate. This motion may be graduated at will and determines the length of the mortise. The slight curvature at the bottom of the slot is no objection.

Figs. 538 and 539 show two designs for the largest class of work, the older design having a wood frame, while the more recent pattern is of iron. The cutter has horizontal and vertical traverse by levers controlled by stops, and the length of the mortises is governed by stops on the feeding-table, as in the gaining-machines. The cutter-slide is counter-weighted to relieve the strain in widening mortises, and power-feed may be engaged to save time in setting the work. The new machine has capacity for mortises 12 inches deep and 16 inches wide and of any length desired. The high speed and freedom from jar adapt these rotary machines for the heaviest work in hardest or most unfavorable lumber. There seems good reason for the preference felt for them by many engineers.

The reciprocating mortisers belong to four classes. In the first class the chisel is driven from a simple wrist-plate by connecting-links, and the work is fed up to the chisel by the foot of the operator, which depresses a treadle. This type is adapted for cabinet and other work upon light material which is easily lifted. Types of these machines are shown by Figs. 540, 541, 542, and 543. Figs. 540 and 542 show a boring attachment, which is very usual when hard woods are to be handled. In softer woods the chisel may penetrate without previous boring of the holes. The stroke of the chisel being unvarying, the depth and severity of its blow are gauged

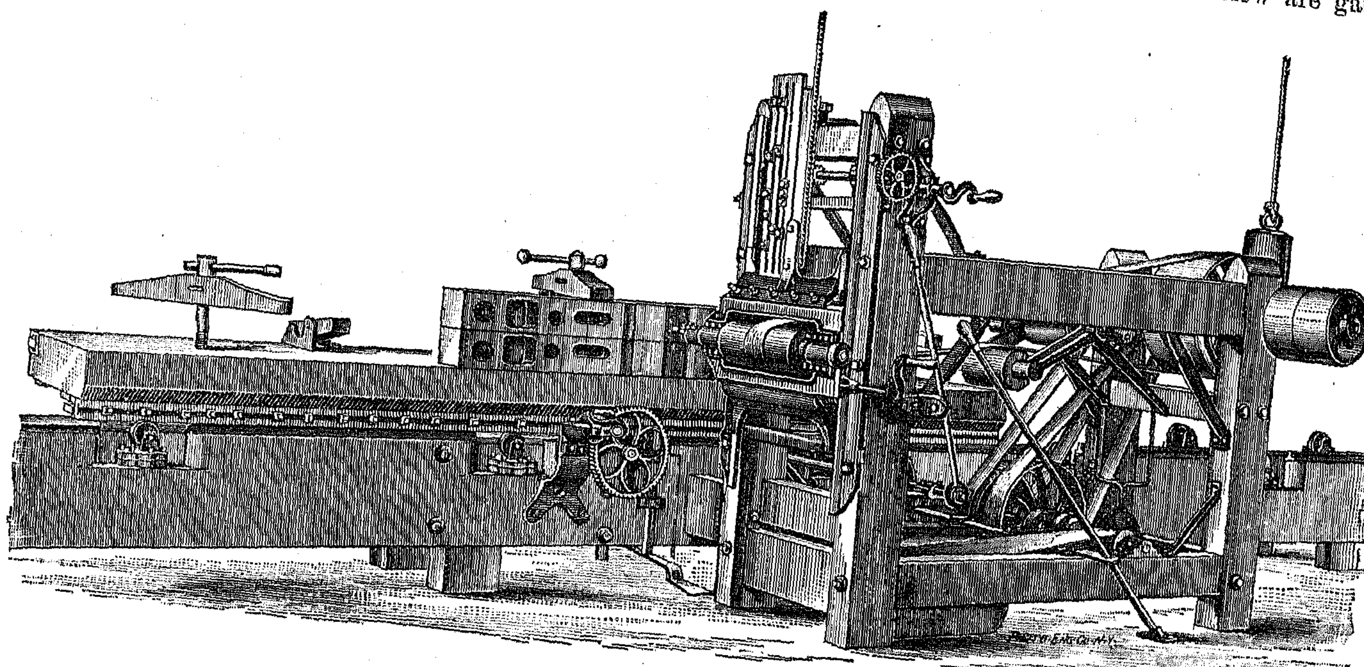

Fig. 538.

by the height of the treadle, and this may be made progressive. The work may be clamped to the table and fed along sidewise by rack and pinion, or it may be held in the hands only. The tables are made adjustable for various thicknesses by screws geared to crank-arbors, or by compounding the table vertically. The depth of the mortise is gauged by the fall of the treadle. In Figs. 541 and 542 the treadle is compound. In the former case the

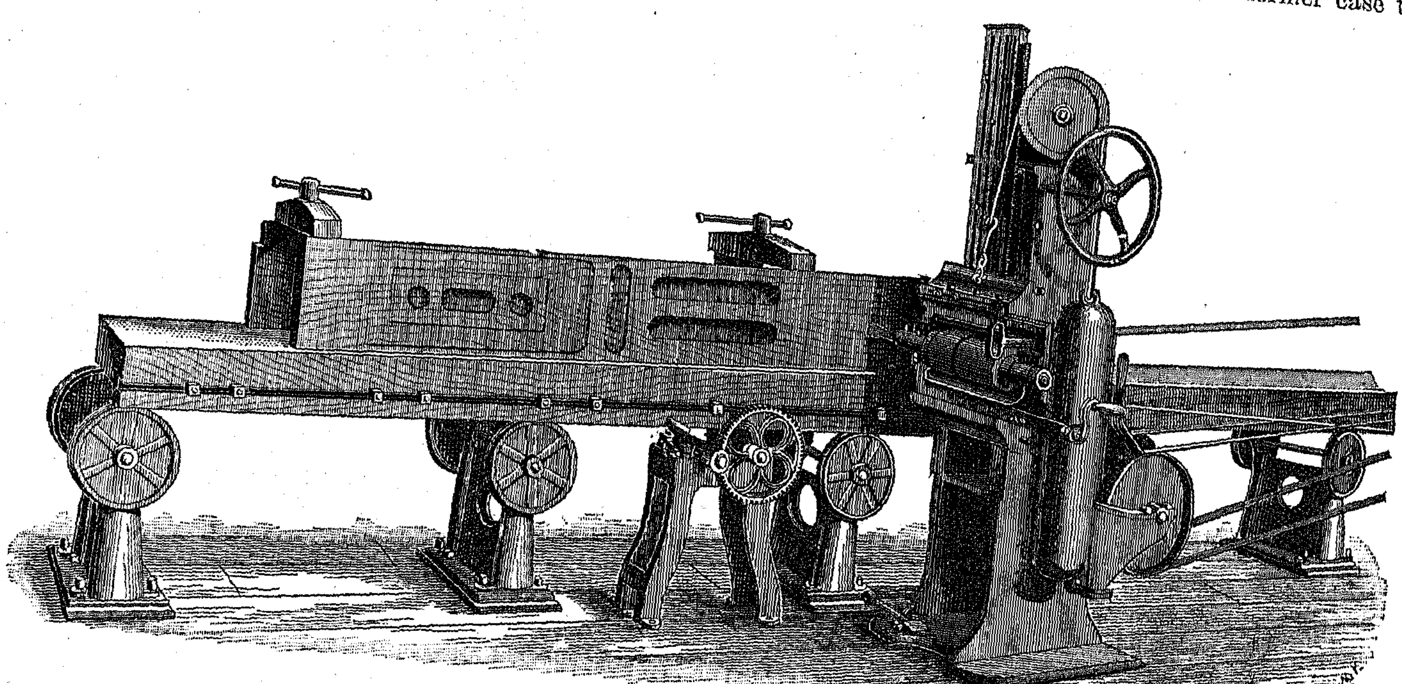

Fig. 539.

adjustment is by the set-screw. In the latter case it is by pawl and segment of a ratchet-wheel. In the designs of this class the treadle and the foot of the operator must receive and resist all the blows. In Figs. 540 and 543 the treadle resistance is so distributed by the truss construction that a large component of the deepest blows passes into the axis of the treadle and relieves the foot-pad. Ease to the operator is also secured by increasing

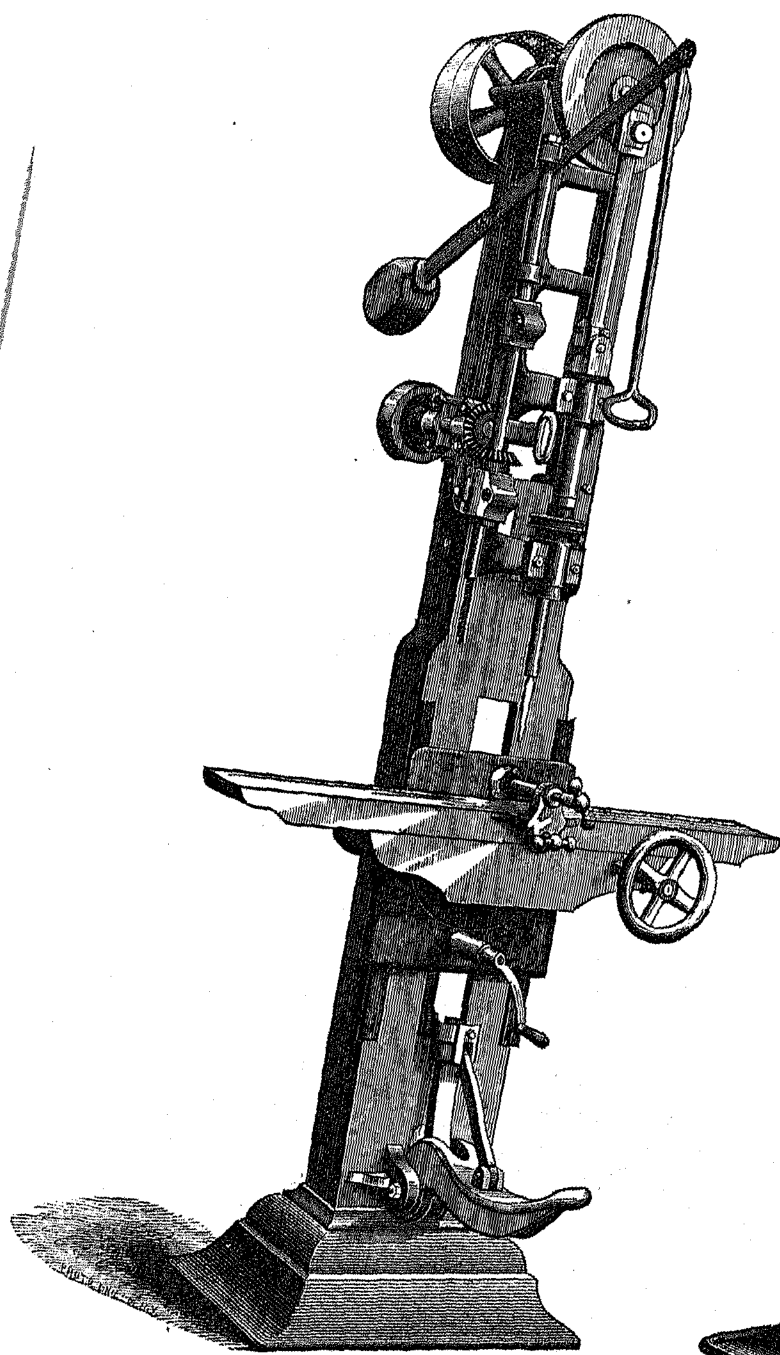

Fig. 540.

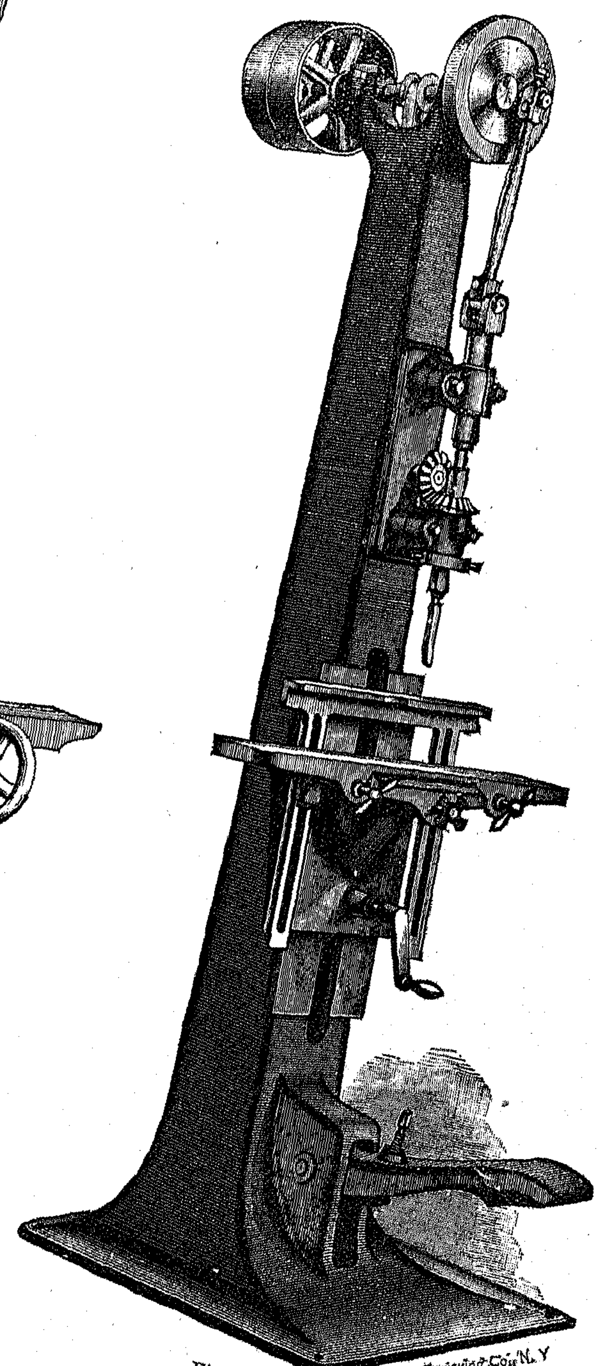

Fig. 541.

Photo-Engraving Co., N. Y.

the inertia of the table and by running the chisel at very high speeds, which is possible when the reciprocating parts are light. The usual speeds are 500 blows per minute. The double wrist-plate design of Fig. 543 permits 800 blows per minute. It is necessary to reverse the chisel at intervals to secure the proper action of the spurs and straight ends to the mortise. This is done by several different devices. Figs. 540 and 543 use the round belt

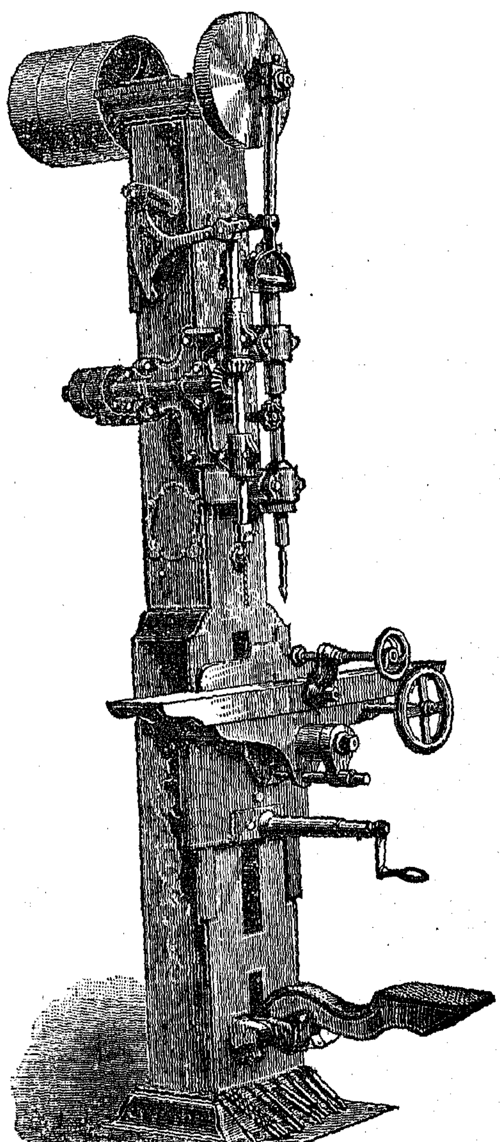

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Fig. 542.

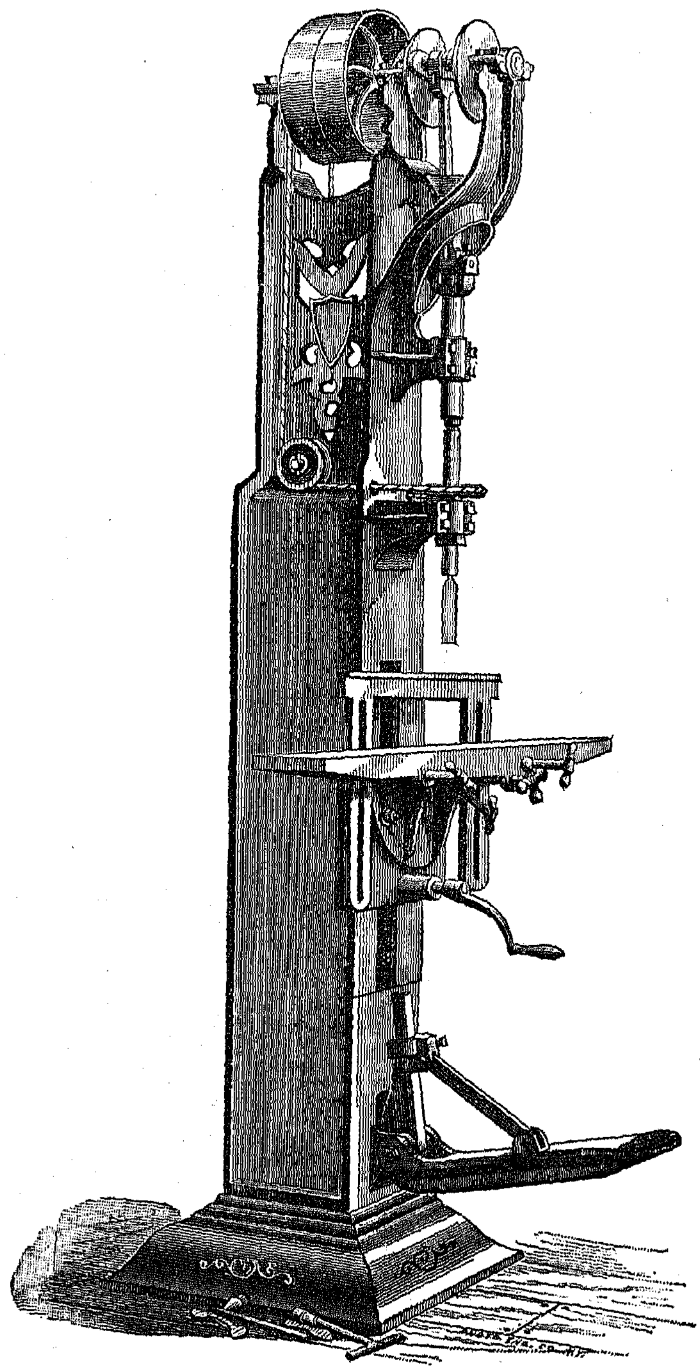

Fig. 543.

device, which slips around the pulley, except when the release of stops permit the bar to turn. In Fig. 541 flat belt is used and the pair of bevel-gear. In the tools of the builder of Fig. 542 there is a bevel-gear on the splined chisel-bar which is in gear with corresponding sector of a bevel-wheel. As the treadle rises it lifts a wedge-point, which strikes a corresponding wedge-point connected to the sector, and reverses the chisel, even if the machine is not running. This latter feature is often a convenience. The reversal of the chisel-bar necessitates an extra joint in the mechanism, which is to be avoided when possible. The rolling fulcrum for the boring-bar of Fig. 542 is a neat feature and avoids a slotted joint or an extra link.

Fig. 544 illustrates a unique machine with two reciprocating chisels. The machine shown is specially fitted for hub-work, and will stagger the mortises as well as do them straight. The table is lifted automatically by a cam-bearing on a roller. The cranks are connected by a drag-link, and the wrist-plate has a brake. The feed for raising the treadle is intermittent and easily disengaged.

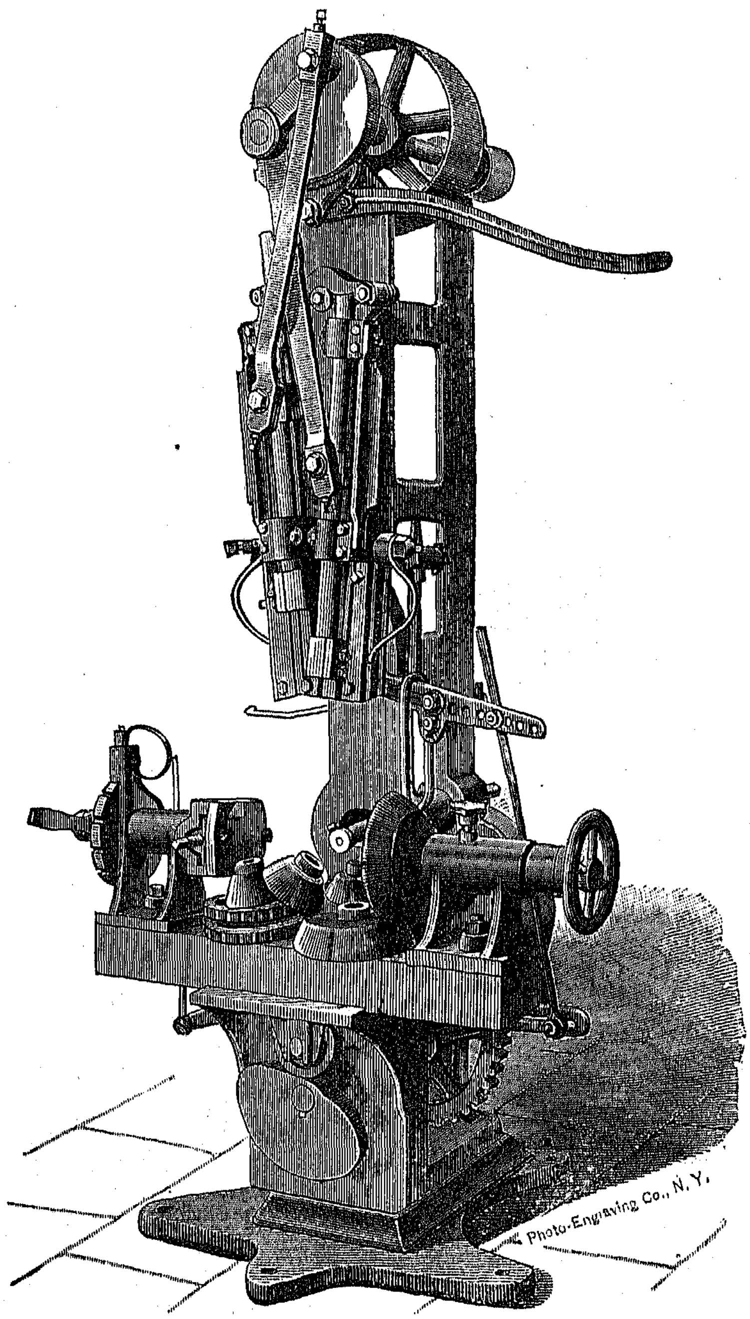

Fig. 544.

The second great class of mortisers includes those in which the table is fixed and the crank-shaft rises and falls to vary the depth of the blow and the mortise. Fig. 545 illustrates a machine of this class, with boring attachments. It has the advantage that it is the rotating parts which receive the shocks of impact before they reach the treadle, and these may be heavy. The counter-weight of the crank and attachments also helps the treadle, but these machines must run at high speeds, and cannot withstand the slower speeds in the form shown. In the heavy hub mortiser by the same builders (Fig. 546) the connection from the crank-shaft below to the abutment above is by an elbow-joint. As this is straightened out by the treadle the chisel-point, with constant throw, comes lower and lower. The elbow is straightened by flexible connection passing over an eccentric disk, so that the leverage of the

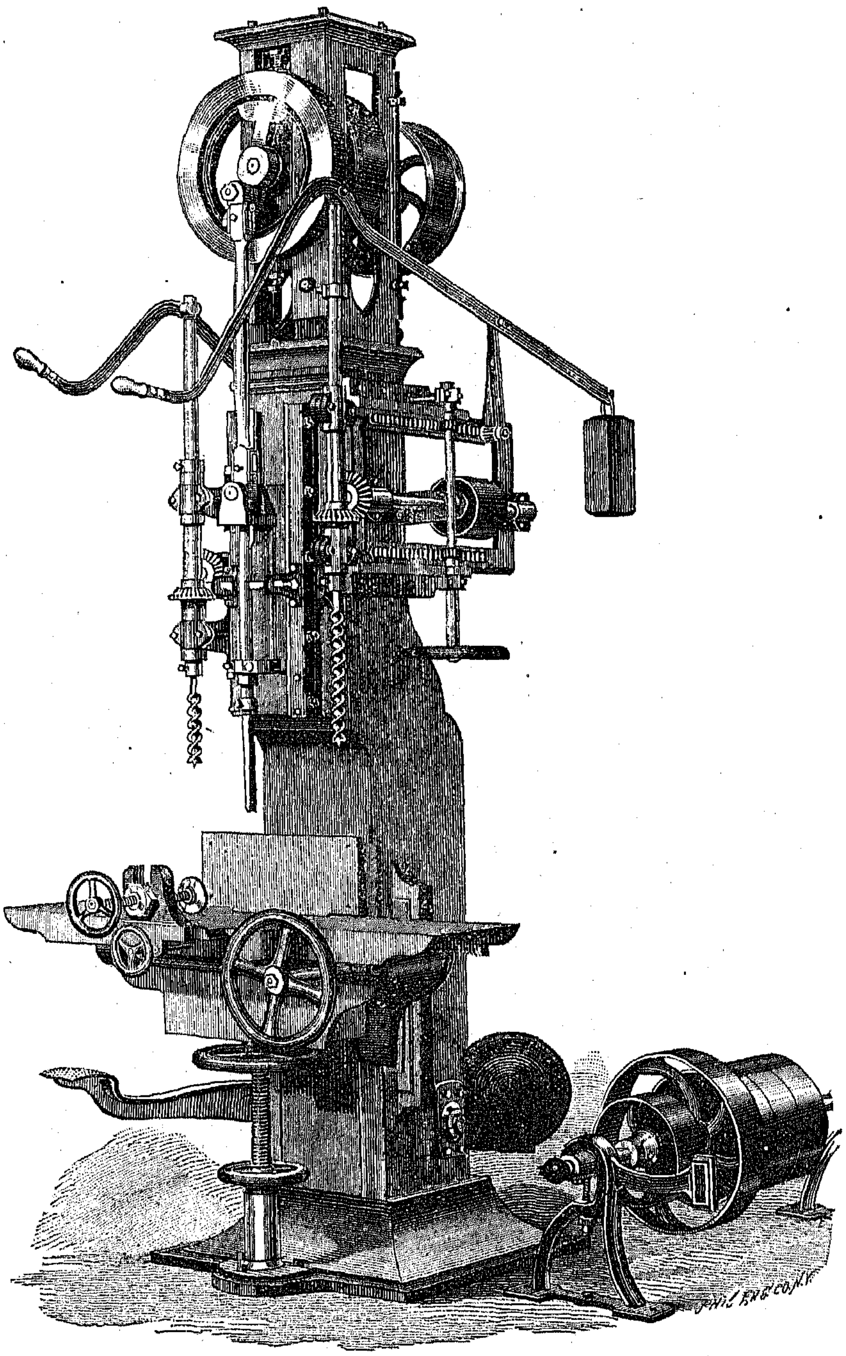

Fig. 545.

treadle is greater as the blows are heavier. The crank-shaft frame is counter-weighted. This is a manifest improvement on the earlier designs, in which the crank-shaft floated directly from the treadle. The third class of chisel-mortisers includes those in which the motion of the bar is made variable by varying the length of the lever-arm which drives it. This may be done by varying the crank-arm, or, as in Fig. 547, by making the crank swing a pivoted lever, upon which slides the wrist-block which drives the chisel. The position of the block is controlled by the links from the treadle, and the stroke may vary from nearly the full stroke of the crank to almost zero.

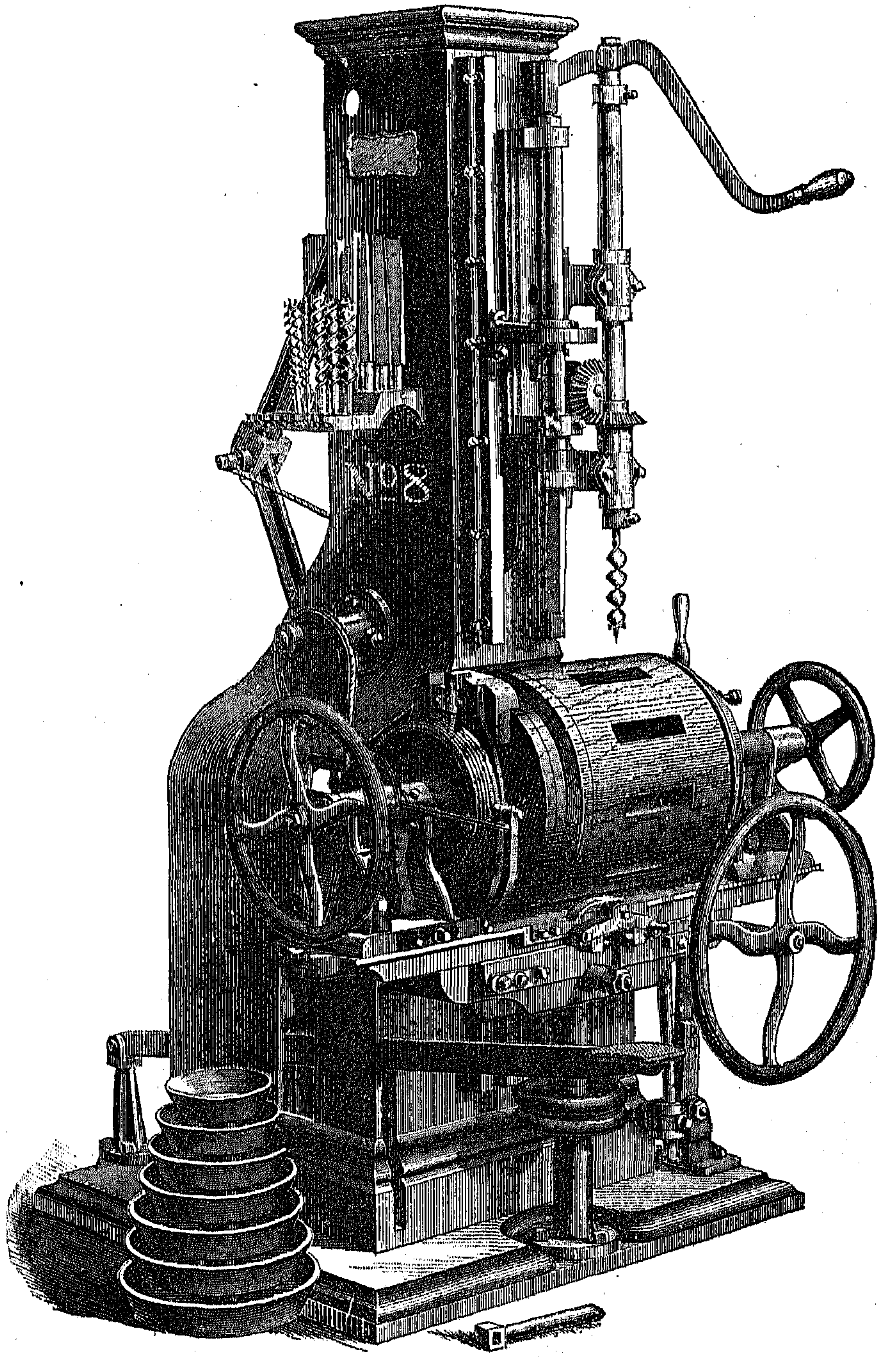

Fig. 546.

But this variation takes place on both sides of the central position of the chisel, and the stroke must be twice as long as the depth of the mortise when measured from the position of rest. This limits the speed of the tool, and multiplies the number of joints between the bar and the crank-pin. The fourth class includes the designs of the type shown by Fig. 548. In this form the stroke may be graduated from zero to the full throw of the crank, but the still point is when the chisel is at the top of its stroke. The variation is caused by varying the length of the line between the crank and the head of the chisel-bar. The connecting-rod is jointed in the middle, and a third

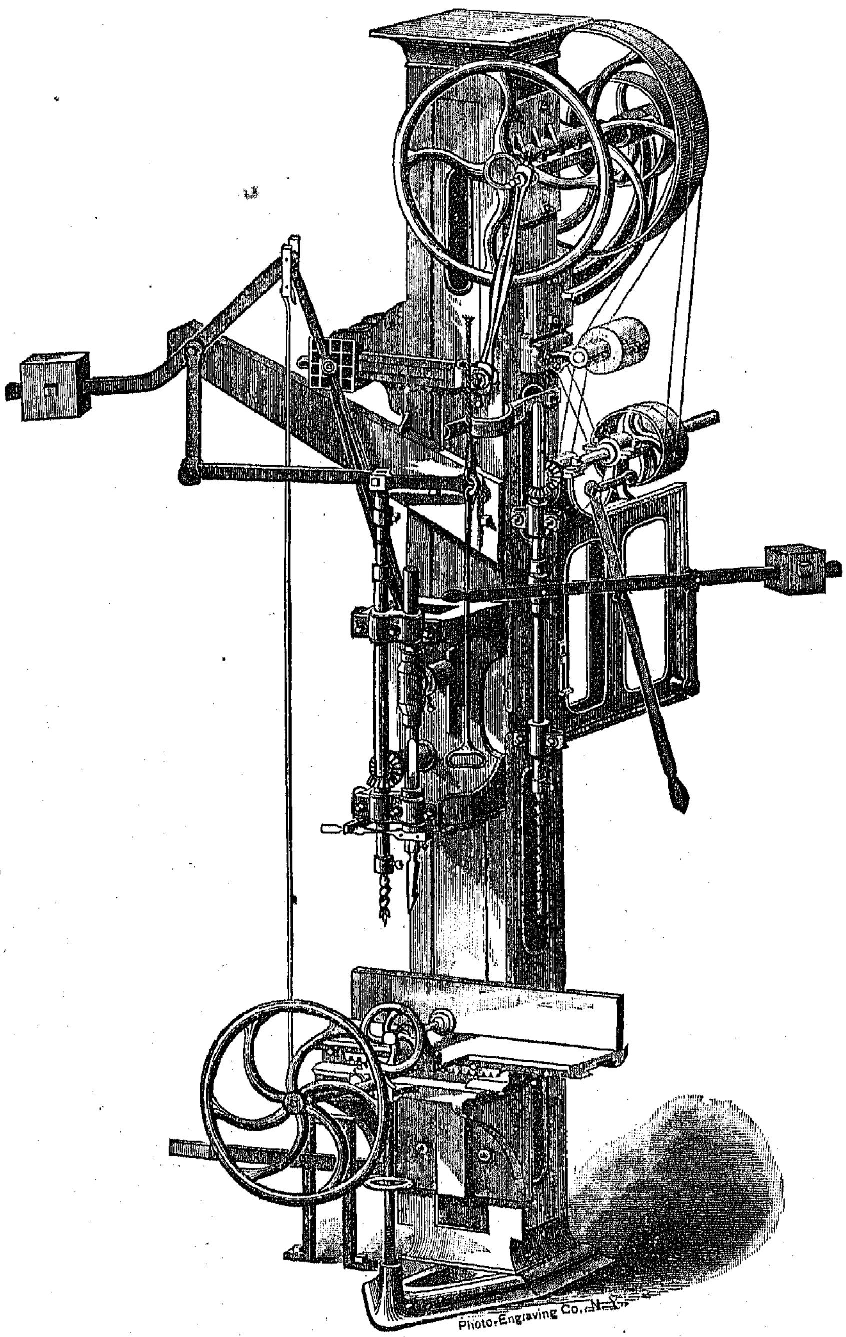

Fig. 547.

link may throw the former into an elbow or straighten it out. When the rod is bent, the thrust of the first link is entirely oblique to the travel of the bar, and it causes no motion in the latter. When the links are straightened, the whole thrust goes into the bar. At intermediate points a component is absorbed in the third link, and the rest causes graduated motion in the bar. The third link is controlled by the foot-treadle from the end of the crank shown, which is counter-weighted. The boring attachment on the left slides outward by rack from the hand-wheel for general boring. The other at the right is in the line of the chisel for mortising.

The fifth class of chisel mortisers includes those which have a progressive downward motion of the chisel-bar to the required depth from a still point, but are without flexed joints in the links. Such a one is shown by Fig. 549. The chisel-bar is worked from the front end of a vibrating beam, pivoted at the middle. At the rear end of this beam is an oscillating box, to which fits a lever which is worked by a connecting-rod from the wrist-pin on the balance-wheel. This second lever is adjusted for position in the oscillating box by a rack and pinion. When the box is near the center of motion the chisel-bar is up, and it has no stroke. As the lever is drawn forward the stroke increases in length but diminishes in power. The boring-mandrel has a special belt-motion, by which it can be driven either in line of the chisel or at any point across the work. In another somewhat similar design, instead of

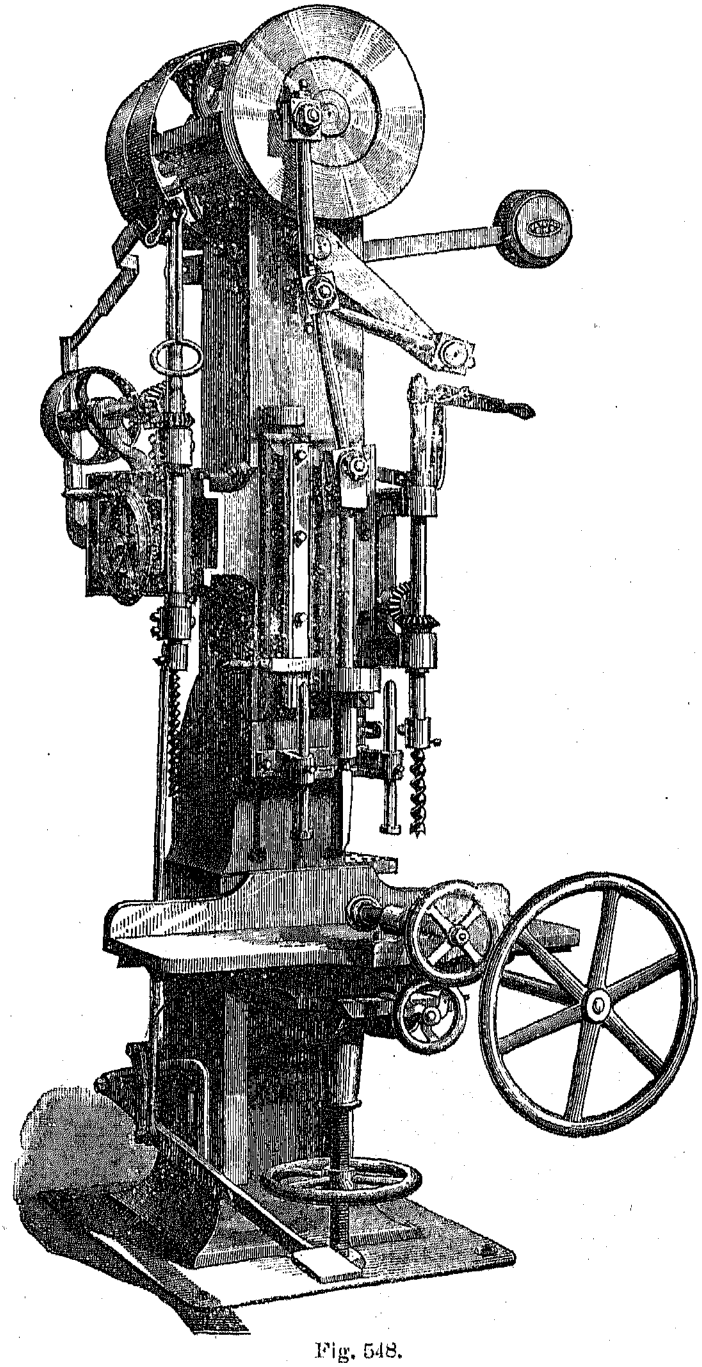

Fig. 548.

shifting the second lever, the connecting-rod is jointed as in the fourth class, and the third link is moved from an arm which carries a quadrant with worm-teeth driven by a worm. As the worm is turned in one direction the links pass into an elbow-joint, and the motion of the chisel grows less and less. The worm-shaft is turned by a belt from a shaft driven by a three-cone combination, the friction being by paper on iron. The jar of the links is received by the worm, which is held from slipping on its shaft lengthwise by a stiff steel spring. This receives the shocks and none reach the foot-treadle. A counter-weight puts into action the cone, which lifts the chisel, and the downward feed is given when the weight is overcome by the foot of the operator on a treadle. The flexed elbow-joint takes up the bar to a point 1½ inches higher than the top of the stroke when the links are straight. The reversal of the bar is effected by a round belt upon a grooved wheel. This belt is prevented from acting during the stroke by four stops upon the face of a horizontal wheel. These stops are alternately in different planes, and the motion of the treadle releases one stop but catches the second. This causes a revolution through 90°. The release of the treadle releases the second stop and catches the third, whereby the bar passes through 90° more, or through a half revolution in all. The reversal is thereby always effected in air, when the chisel is up, and may be entirely automatic.

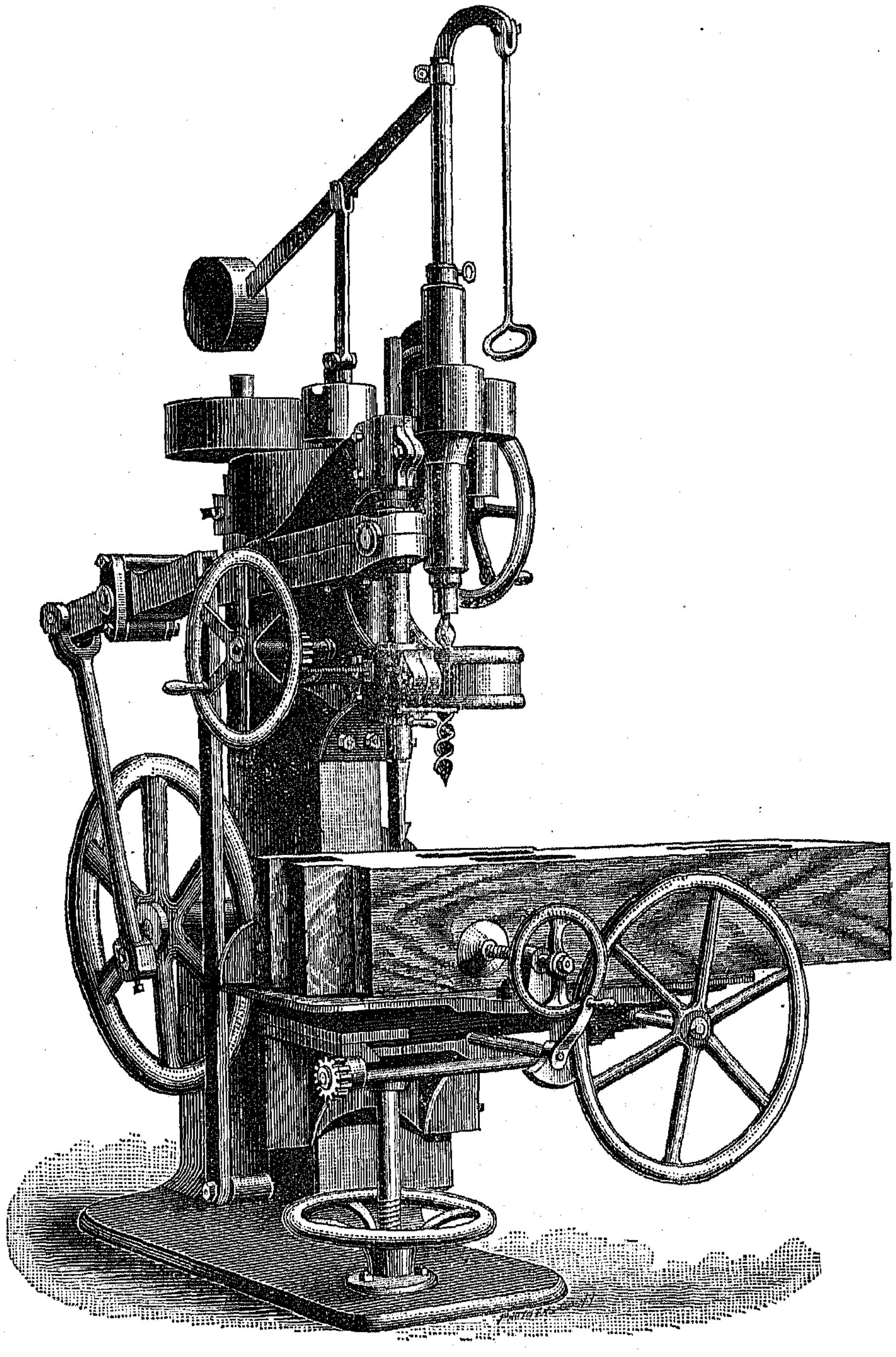

Fig. 549.

The mortising-machines belonging to the various classes illustrated give a wide range of adaptation. With one type or another every class of work can be satisfactorily done, and the details of their construction are of a high grade of mechanical excellence.

§ 54.

BORING-MACHINES.

ese machines belong unmistakably to the class of tools acting both by paring and severing the fibers. The spur acts to sever material which is split off by the edge.

In the several mortising-machines are seen types which illustrate post-boring machines. A vertical shaft, splined, is driven by a pair of bevel-gear. A hand-lever attached to a collar at the upper end draws down the mandrel which practically feeds itself, and a counter-weight retracts the tool when the hole is made. For the larger post-borers, such as Fig. 550, a second motion horizontally is given by compounding the bracket, so that

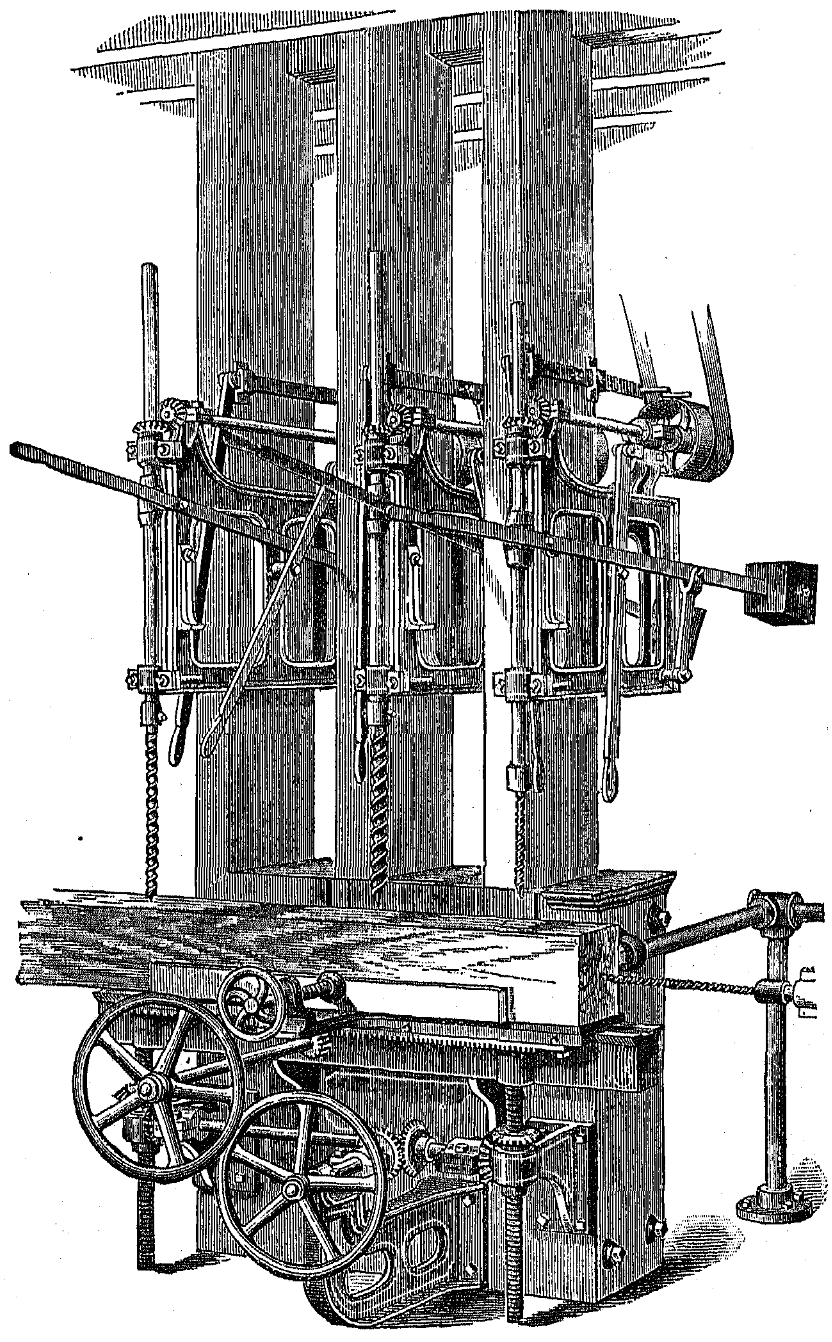

Fig. 550.

work of greater width can be bored. In the design shown, which is for car- and bridge-work, the heavy table and work is raised by geared screws, and its horizontal adjustment is made by rack and pinion. The posts may be spaced for standard intervals, or at random. The brackets are pulled forward by levers, the belt-shaft being splined. For horizontal boring in the ends of long timbers, the device of Fig. 551 is used. A similar bracket-

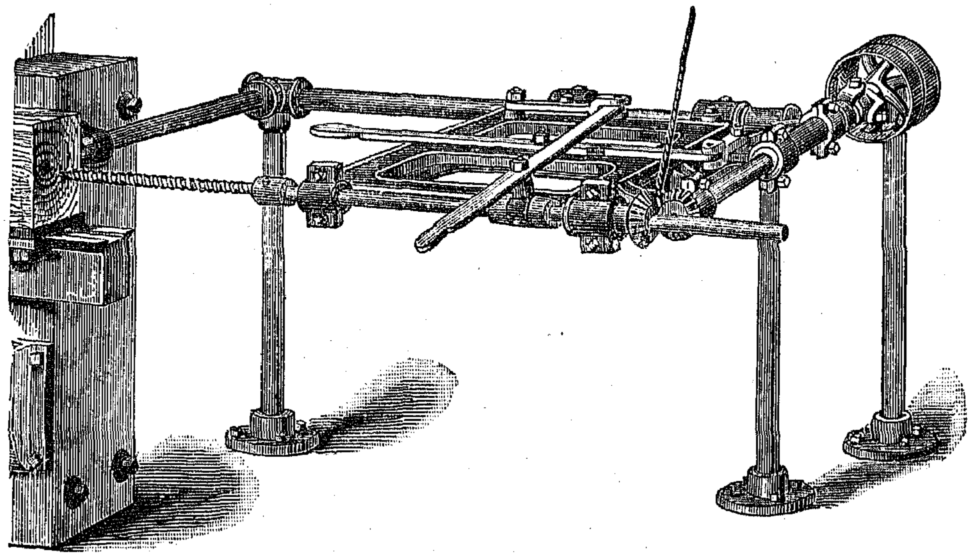

Fig. 551.

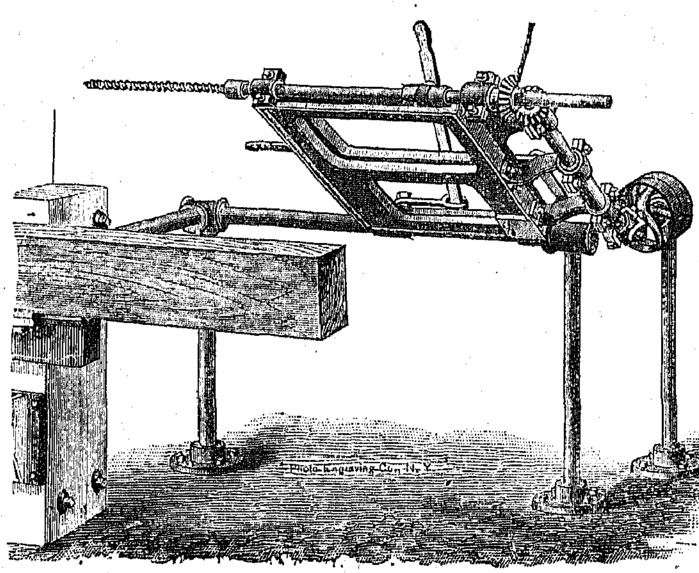

Fig. 552.

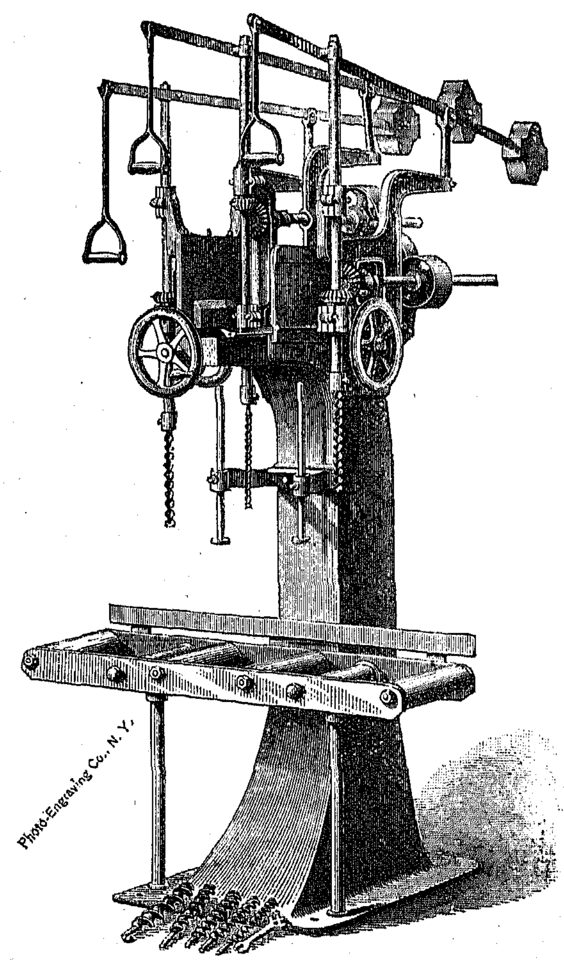

Fig. 553.

frame is pivoted at the rear and counter-weighted. The pulley-mandrel has a universal joint in it so that the whole apparatus may be lifted so as to let the timber pass it (Fig. 552). A standard iron vertical boring-machine for several bits is illustrated by Fig. 553. The two outer frames are fed forward by rack and pinion from the hand-wheels, and the central one by a screw. They are all driven by one belt, the pulley on the central shaft being larger than the other two. That causes it to turn more slowly, and fits it for the largest auger of the set. The table has friction-rolls for the easy handling of the heavy work for which the tool is adapted. A type of vertical borer, designed to be secured to a post, is shown by Fig. 554. The mandrel is driven by a quarter-twist belt, and has no horizontal traverse. The pressure for feed may be by hand or by foot. For horizontal boring in car and large work the rotary mortisers may be applied, or tools with the same capabilities.

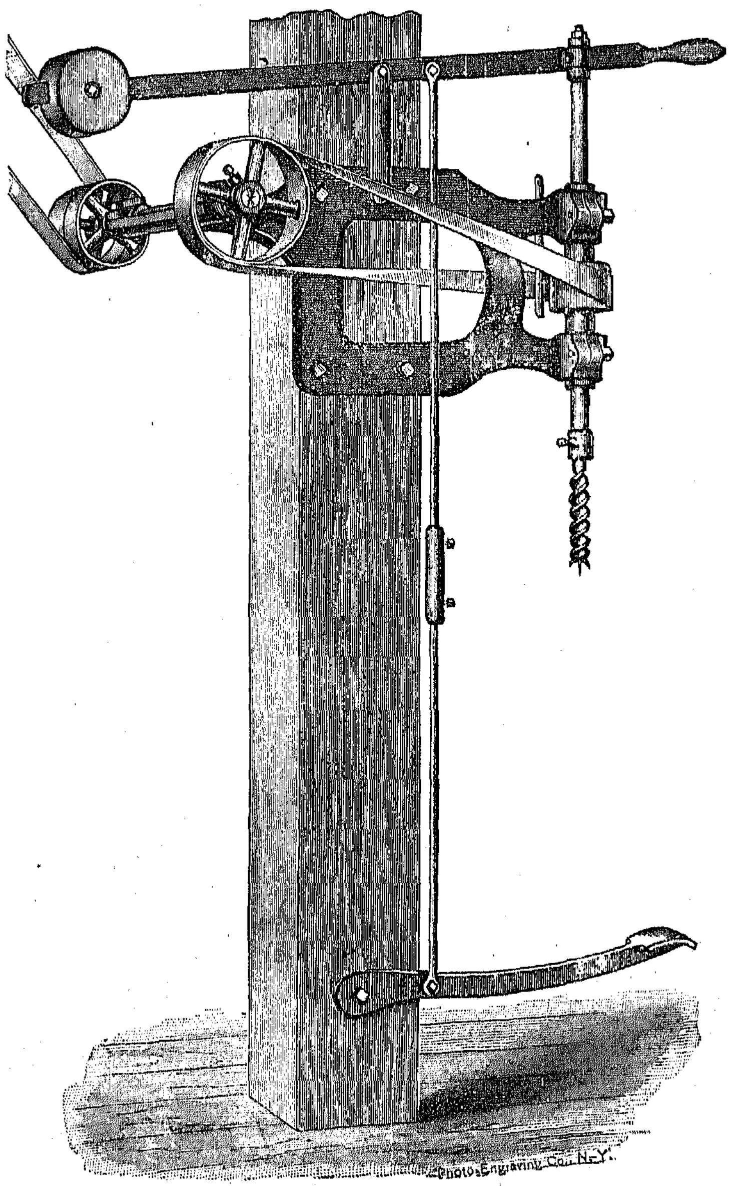

Fig. 554.

Figs. 555 and 556 show their general construction. A counter-weighted slide carries the boring-arbor, and gives vertical adjustment by screws and hand-crank. Power is furnished directly by belt over guide-pulleys or from the counter in the mean horizontal plane. Fig. 555 shows the use of a stop for gauging the depth of holes. The feed is by the handles shown. A machine for angular or radial boring is illustrated by Fig. 557. The belt is tightened by a pulley with a weight hung in a slack bight overhead, by which any elevation or angle may be secured for the mandrel. This machine meets a need in car- and bridge-work, where truss-rods are to pass obliquely through the ends of the timbers. It will also bore with the grain on the ends of work. For the smaller work of miscellaneous shops, what are known as universal machines are approved. As in the larger types, these are vertical and horizontal.

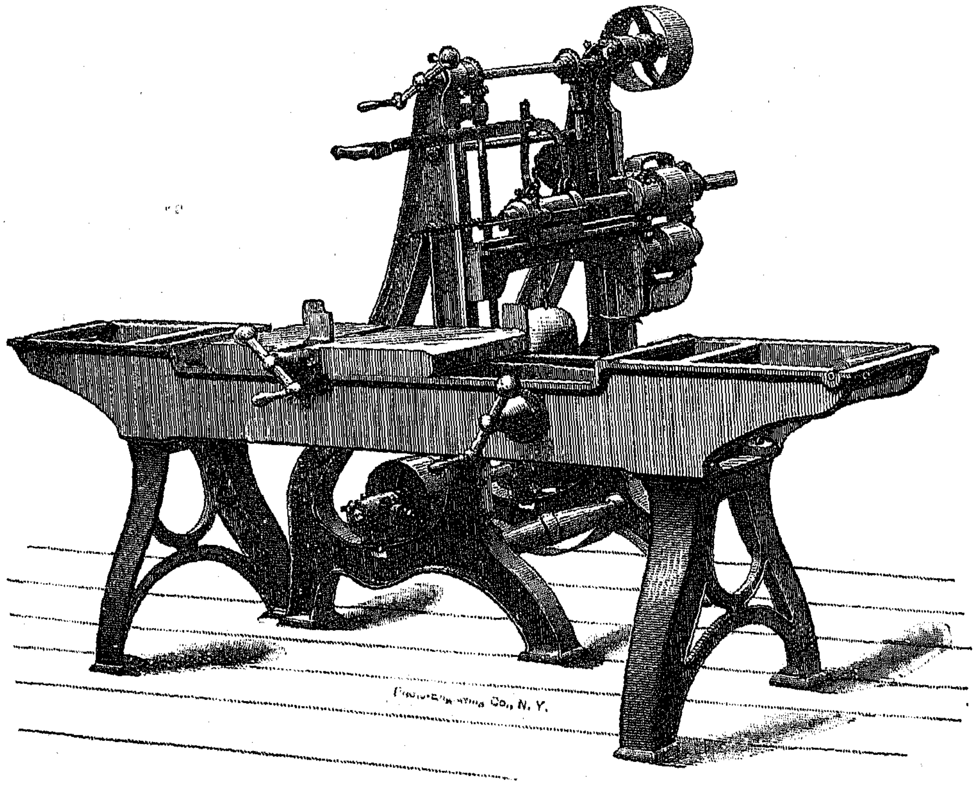

Fig. 555.

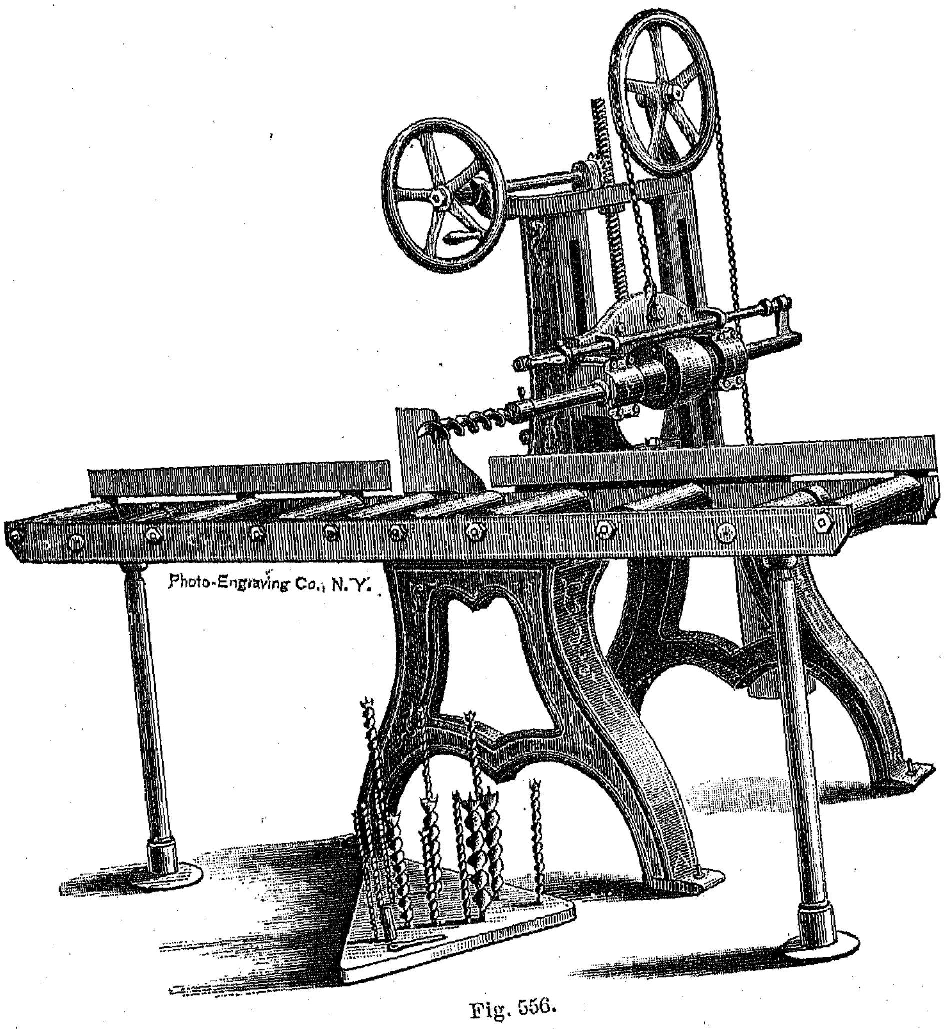

Fig. 556.

Figs. 558 and 559 are types of the vertical machines, which are driven by a belt over guide-pulleys. Provision is made in most of these machines for giving two or three speeds to the mandrels to adapt them for augers of different diameters. The tool is brought down to its work by a foot-treadle, so as to leave the hands free to hold the less stable work. The tables are adjusted easily, by rack and pinion in one case, and by a screw in the other The universality is attained by compounding the tables. In Fig. 558 the upper part of the table-upright rotates to any horizontal angle, and the sectors permit the table to stand at any angle with the horizontal or vertical planes through the bit. In Fig. 559 the table is gibbed to slides, and a double set of sectors is required. There are many smaller vertical borers which have the tables without universal capacities. Many of these have the table rise by a foot-treadle, or the spindle may descend.

The horizontal universal machines (Figs. 560 and 561) require no guide-pulleys, and the cone-pulleys may be on the mandrel. Stop-gauges or collars may gauge the depth of holes when the mandrel is pressed forward by the jointed levers from the counter-weighted treadle. Fig. 560 gives the angles by the screw with swiveling-nut. Fig. 561 is of the same design as the vertical boring-table by the same builders. A very usual type of horizontal

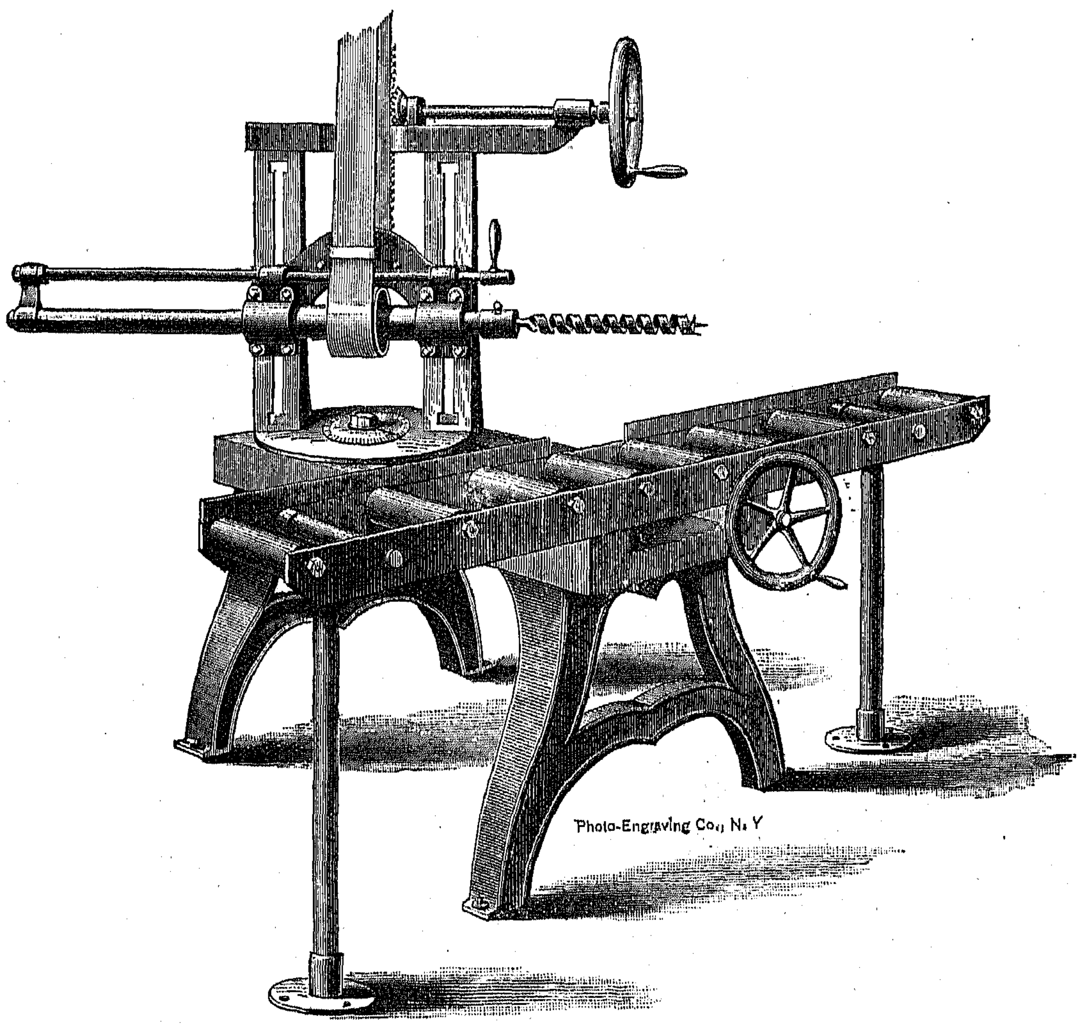

Fig. 557.

boring-machine is illustrated by Fig. 562. It is for work of medium size, and the vertical adjustment of the horizontal spindle is permitted by an arrangement of belt and guide-pulleys similar to that used on tenoning-machines. The tool is brought forward by a foot-treadle, acting by curved links upon the slotted lever at the back. The fence on the table is of hard wood.

In cabinet-work and in pattern-shops it is often convenient to bore two holes at once, at standard distances from each other, as for doweled work. A tool adapted for this duty is illustrated by Fig. 563. The two spindles are belted from the drum below, and are carried in two yokes, which are gibbed to the top of the frame. This top is shaped to an arc of a circle struck from the center of the counter-shaft, and the bits separate equally from a close central position by a right and left screw and hand-crank. The belts are always equally tense, and the fall of the bits as they separate is compensated for by lowering the table. The table rises and falls by the screw in front, and slides on gibbed ways to and from the bits. A stop-gauge below the table may insure standard depths.

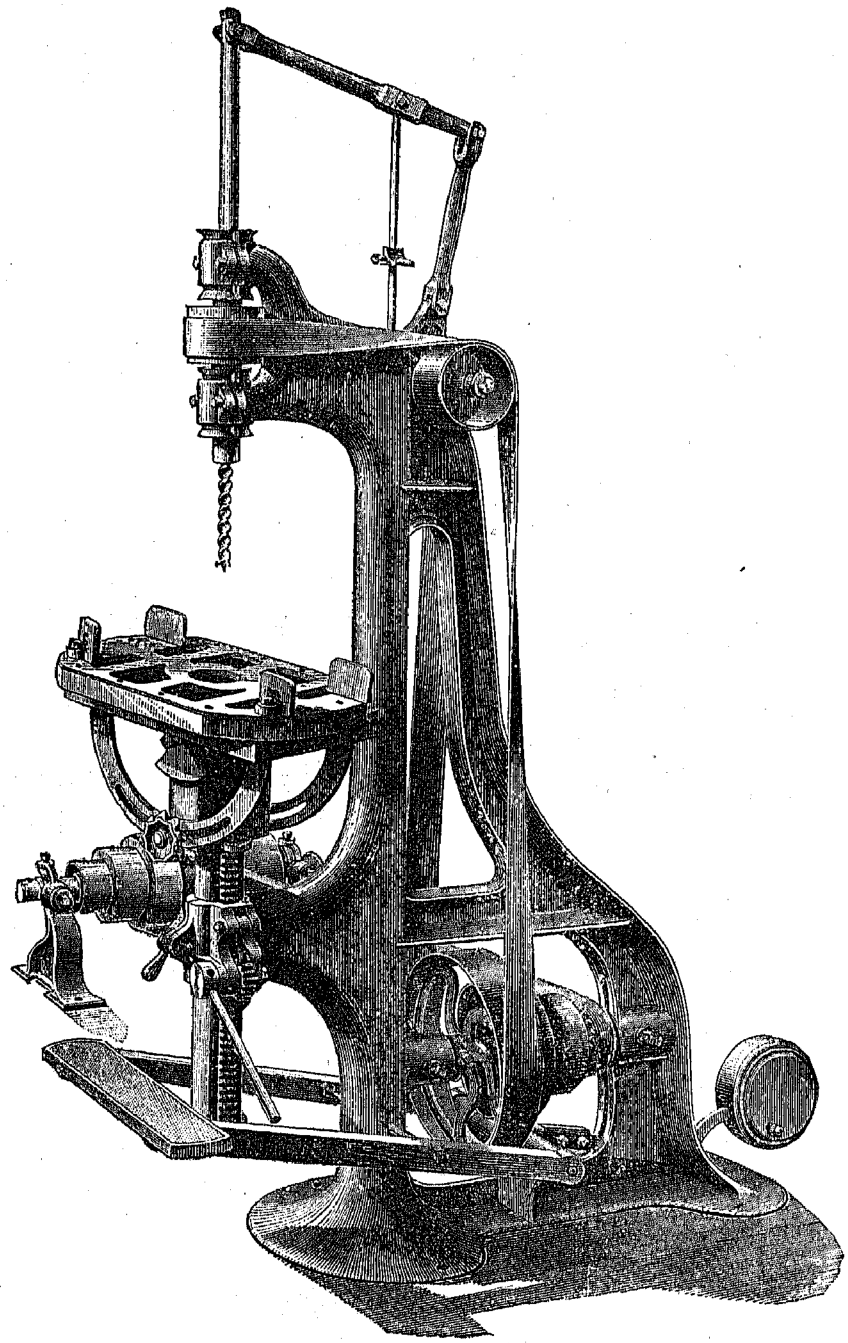

Fig. 558.

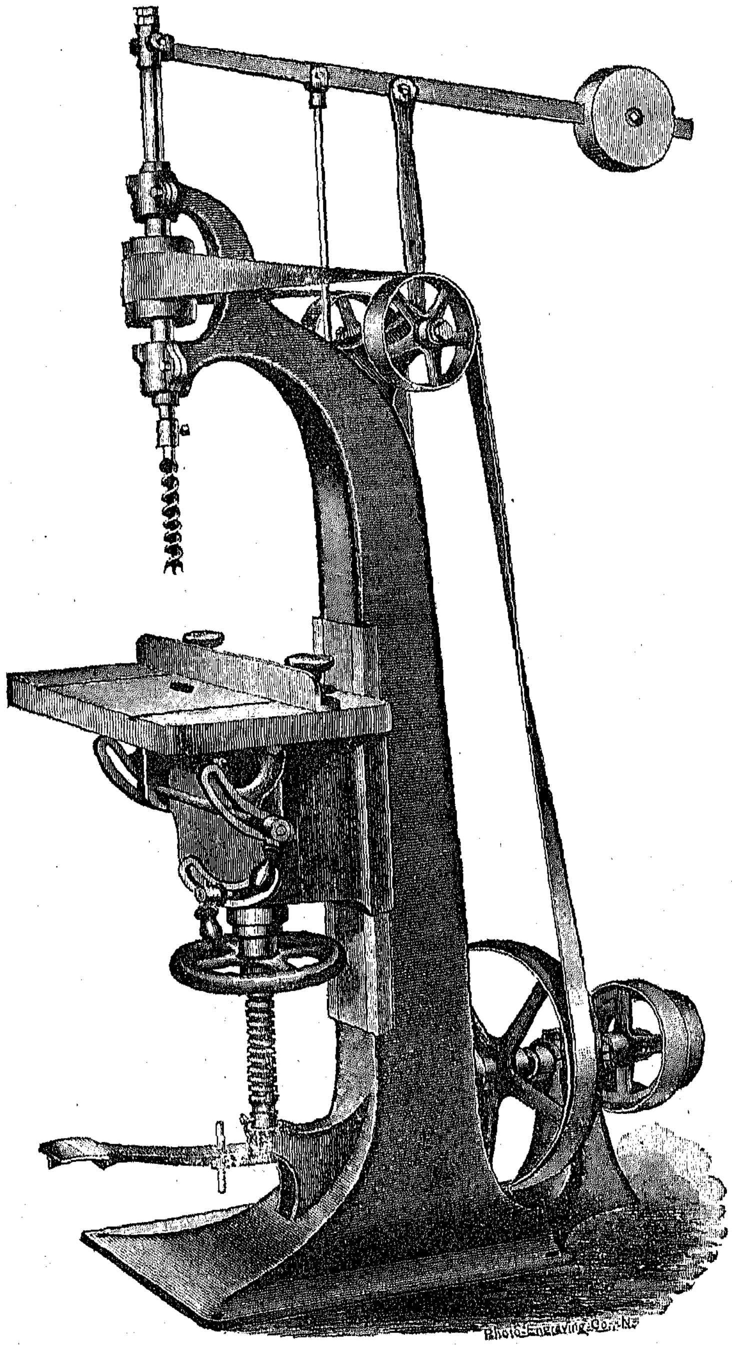

Fig. 559.

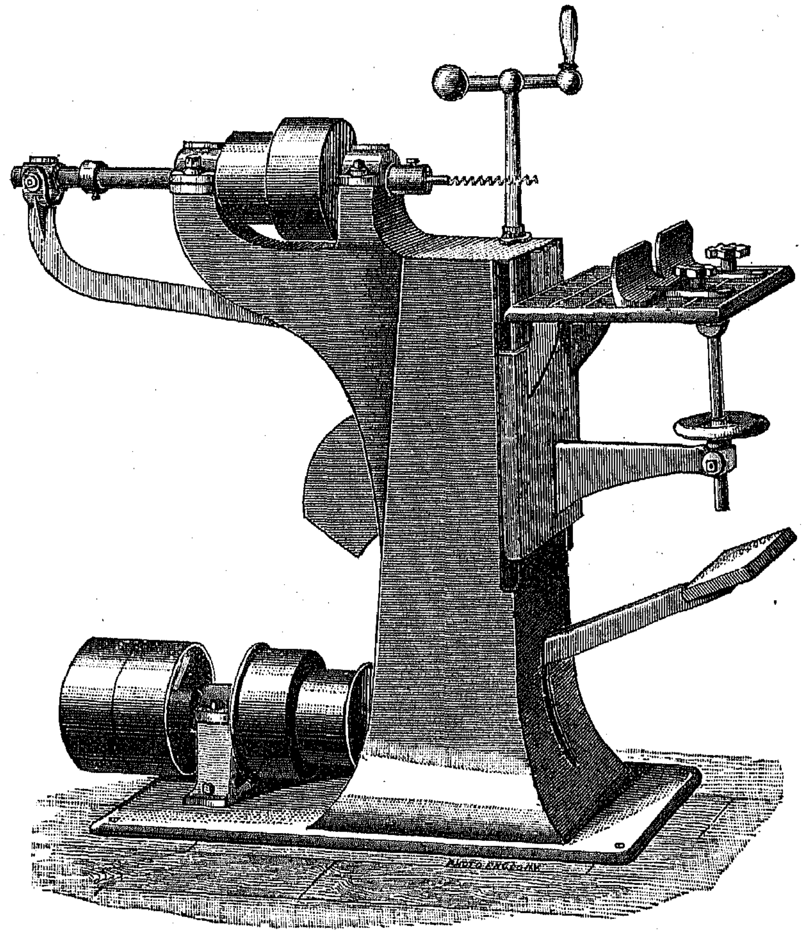

Fig. 560.

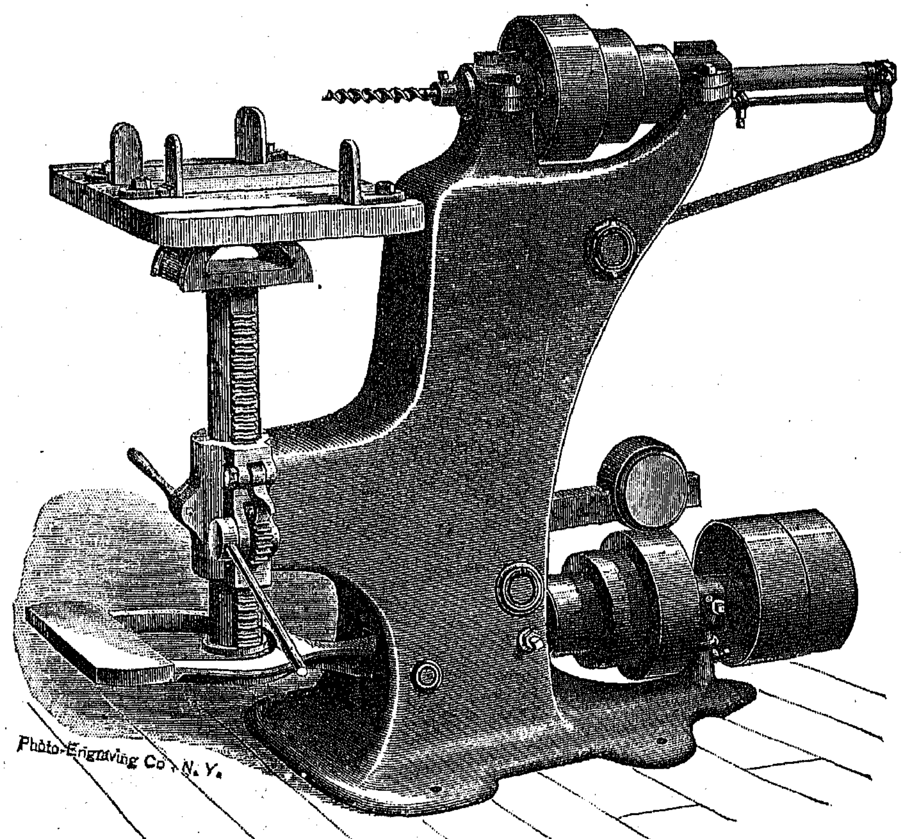

Fig. 561.

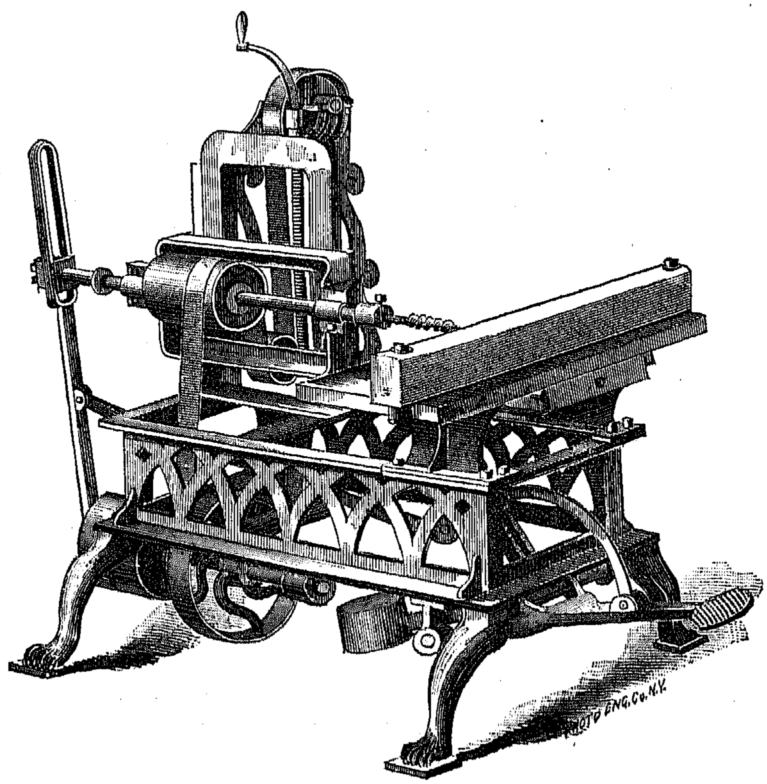

Fig. 562.

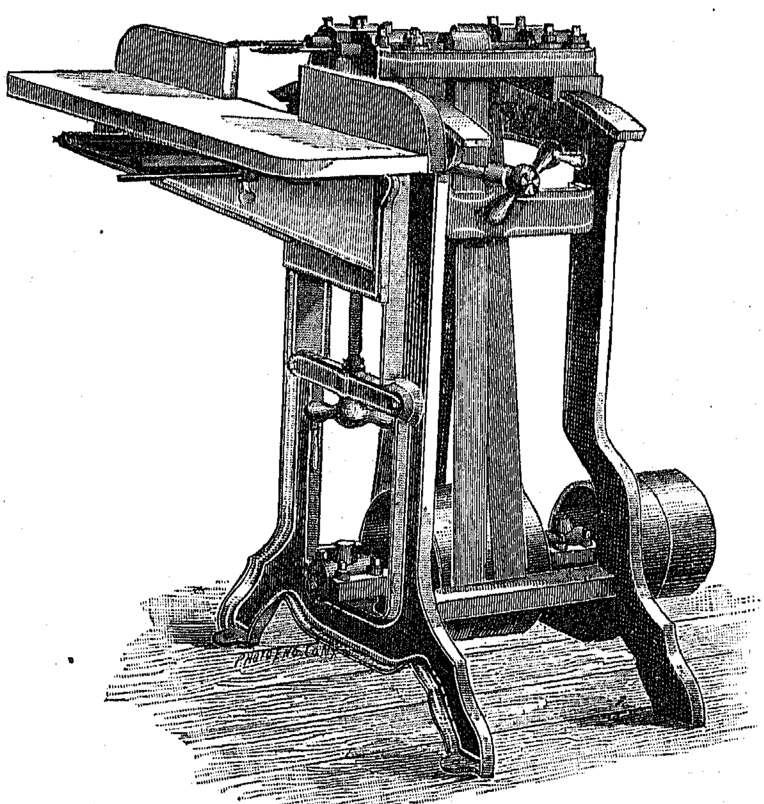

Fig. 563.

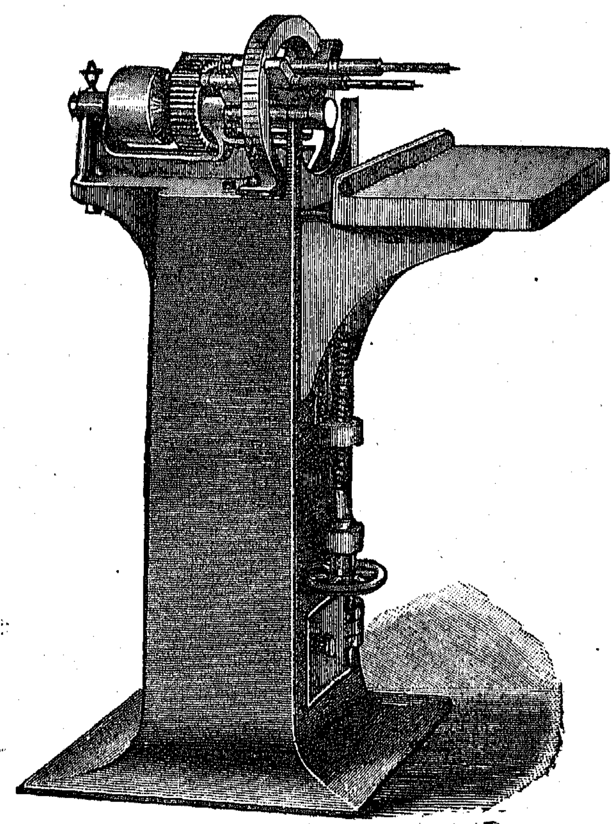

Fig. 564.

Fig. 564 shows a similar tool, but it has the two spindles driven by long pinions driven by a gear, whose center is their center of adjustment. Not only can the bits be brought as near as the diameters of the pinions will admit, but the pair of holes may be drilled at any angle between the horizontal and vertical. The holes may be spaced from 1 inch to 6 inches from center to center. The table is adjusted by screw and hand-wheel, and there are two speeds for the spindle for convenience in the variations of auger and of wood. A tool of this same double class, which illustrates very clearly the close connection between the boring-machines and the rotary mortisers, is shown by Fig. 565. It is primarily designed for boring the holes in the stiles for rolling blinds, or for mortising

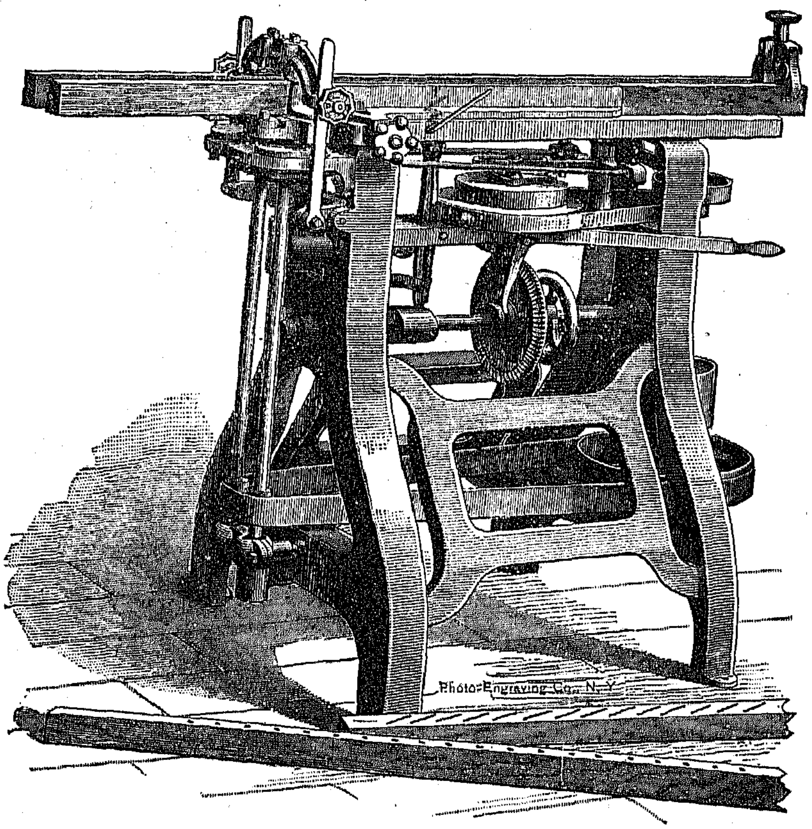

Fig. 565.

for fixed slats. Two stiles are received at once, and are fed vertically upward to a standard depth by a lever. The mortising motion is given from the wrist-pin on the horizontal disk, driven by the bevel-gear below. By releasing the clutch the tool is simply a boring-machine. The mortises may be at any angle with the length of the stiles, and their dimensions are controlled by stops. By making the cutters to work from below the holes clear themselves from chips, which might otherwise catch the cutter and break it. One hundred and fifty holes may be bored per minute, or 60 mortises may be made for stationary slats, and a manifest economy is thus effected.

The mechanical details of the boring-machines of to-day are of high grade. The spindles are of steel, and the thrust of penetration is borne by rawhide washers or by steel or composition steps. Many of them illustrate provisions to take up wear.

§ 55.

I.—MACHINES ACTING BY ABRASION.

SAND-PAPERING MACHINES.

The sand-papering machines correspond to the polishing-wheels for the metals. Their function is the production of a smooth surface upon the woods, that the varnish may produce an ornamental finish. For curved and cylindrical surfaces this power sand-papering has to be done by an endless belt. Upon this an adhesive like glue is spread, and sand or emery of the proper grit is dusted on the surface. There are usually mountings for two belts to employ two operatives and devices for maintaining the proper tension of the sand-belts. There is a great deal of grit and dust given off from such machines, and the boxes must be specially protected from the entrance of abrading particles. This type of machine is trying to the operators, but is required for some types of work. For flat surfaces, such as occur in door, cabinet, and piano-work, a bracket-machine is used such as is shown by Figs. 566 and 567.

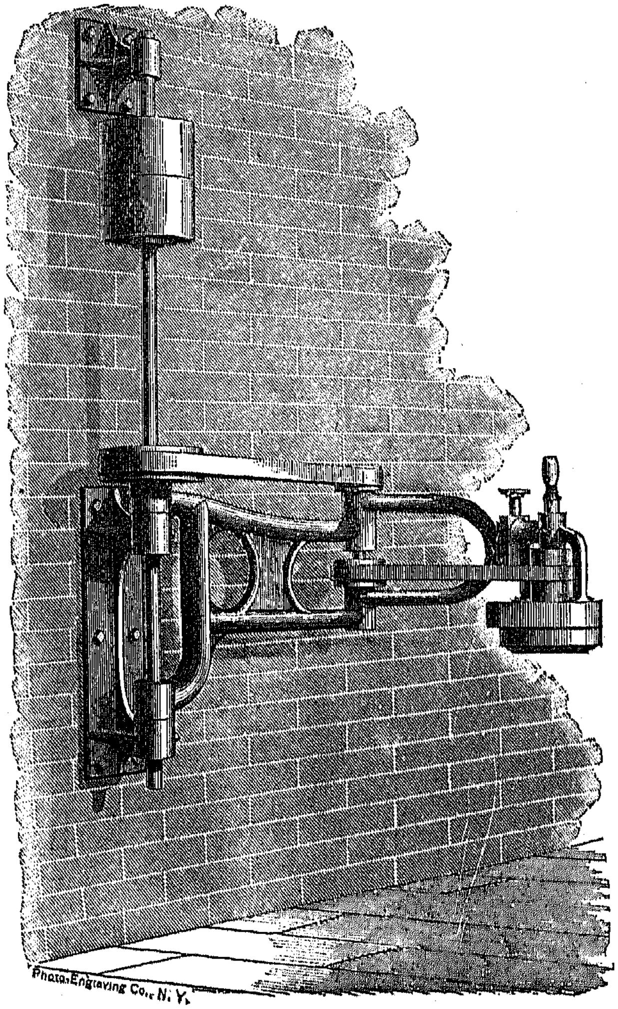

Fig. 566.

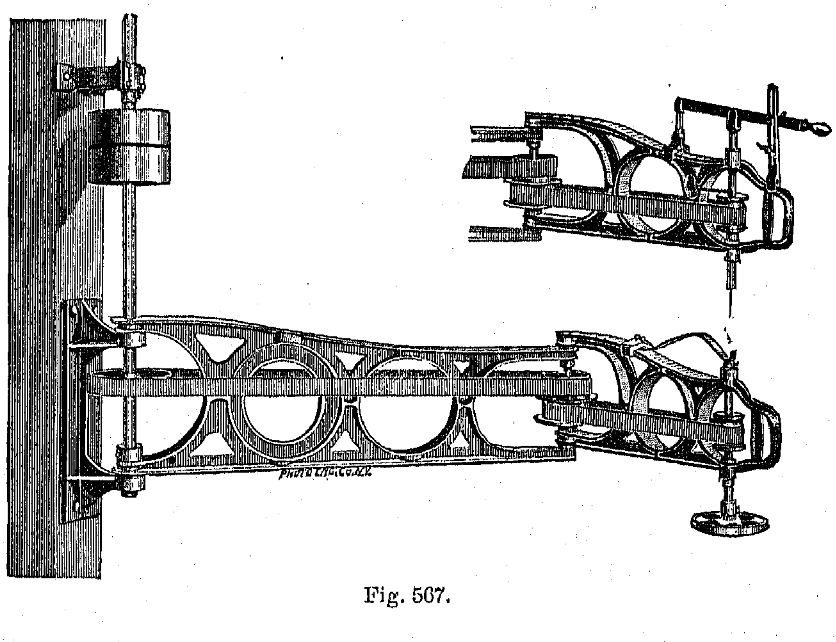

Fig. 567.

A vertical counter-shaft, with pulleys overhead or below the floor, drives a flat disk at proper speed. The bracket is divided to make an elbow-joint, with the pivot serving as idle shaft, to which the counter is belted and from which is belted the disk. This arrangement gives free motion to the disk in every direction. The adjustment of the disk for varying thicknesses is given by a milled-head screw, and the spring-handle of the disk enables the operator to gauge the amount of pressure. In the design of Fig. 567 the disk may be removed, and by a link attachment the spindle may be used for boring. The pressure of the spring is adjustable. A similar device has been applied for fancy wood-carving of large work. Where the work is unmanageable it is better than the system hitherto discussed. In Fig. 566 above the disk is an exhaust-fan on its side, and the arms of the bracket are hollow ducts, through which dust is carried away from the operator and his work. Scratches are less likely to mar the finish. Other designers put the fan on a separate mounting, with a special pipe to the disk, but this makes the arms more cumbrous.

For producing a smooth, even surface, without the circular markings of the bracket-machines, drum-machines are approved. Fig. 568 illustrates a type for hand-feed. The table is of wood, with steel lips. The cylinder is

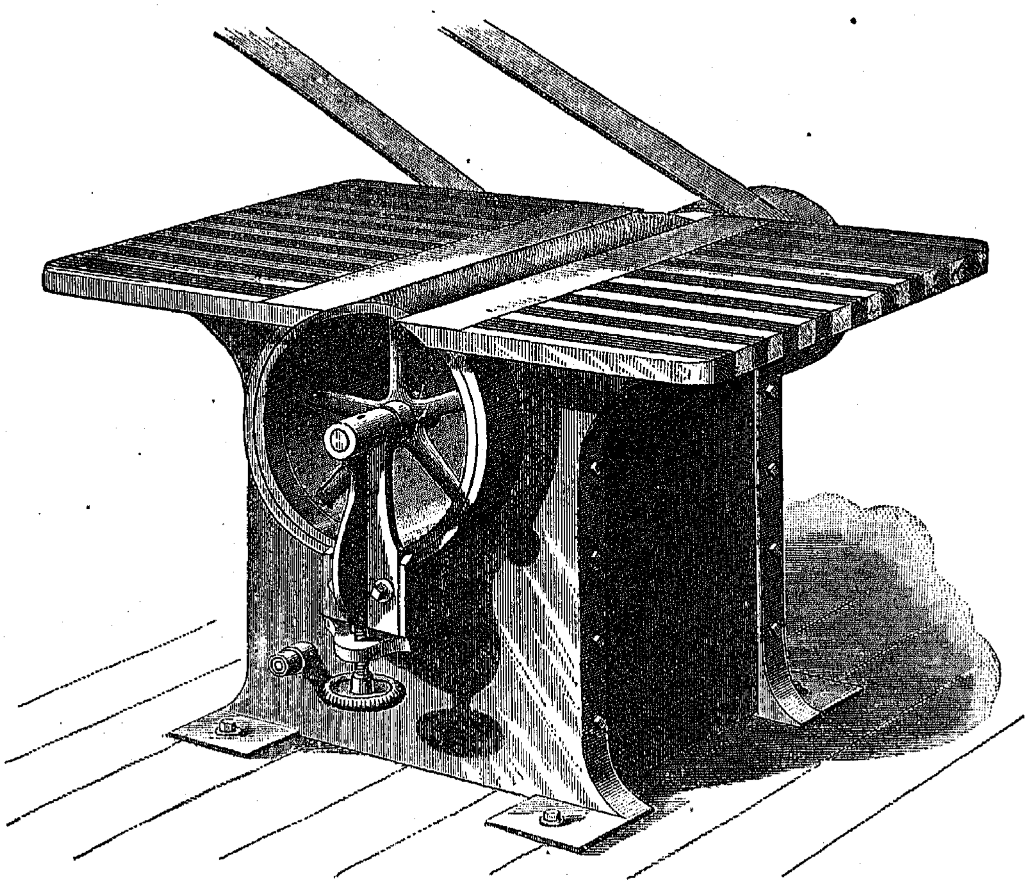

Fig. 568.

adjustable vertically, to regulate the amount of surface to be removed. The cylinder is covered with a flexible cover, which bears the abrading material. The box frame is nearly air-tight, and an exhaust-fan takes away the dust. There are advantages, however, in the regular feed when the gear is driven by power. Fig. 569 shows a machine where the feeding is done by rubber bands, driven by flanged pulleys and the geared rollers. The design of Fig. 570 has the feed given by pairs of smooth rollers, which are adjusted by screws connected by gearing-chain, and are driven from the cylinder through an idle belt-shaft. The elasticity for the pressure of the feed is obtained by rubber springs. For furniture, coffin, cabinet, and piano work these machines of the various types do much better and more satisfactory duty than can be done by hand-labor. They occupy an important place in shops which demand a high finish upon the work they turn out.

The emery-wheel has been recently applied to shape as well as to finish wood surfaces. A coarse or porous wheel—known as a "blubbered" wheel when vitrified—revolves rapidly against the work, which is slowly rotated. Hard woods especially are amenable to this treatment after the roughing-cuts of rapidly-fed machines. Whip-stocks have been smoothed by this process with marked success. But it may be laid down as a principle that unnecessary power is consumed when purely shaping processes must reduce to dust the material they remove.

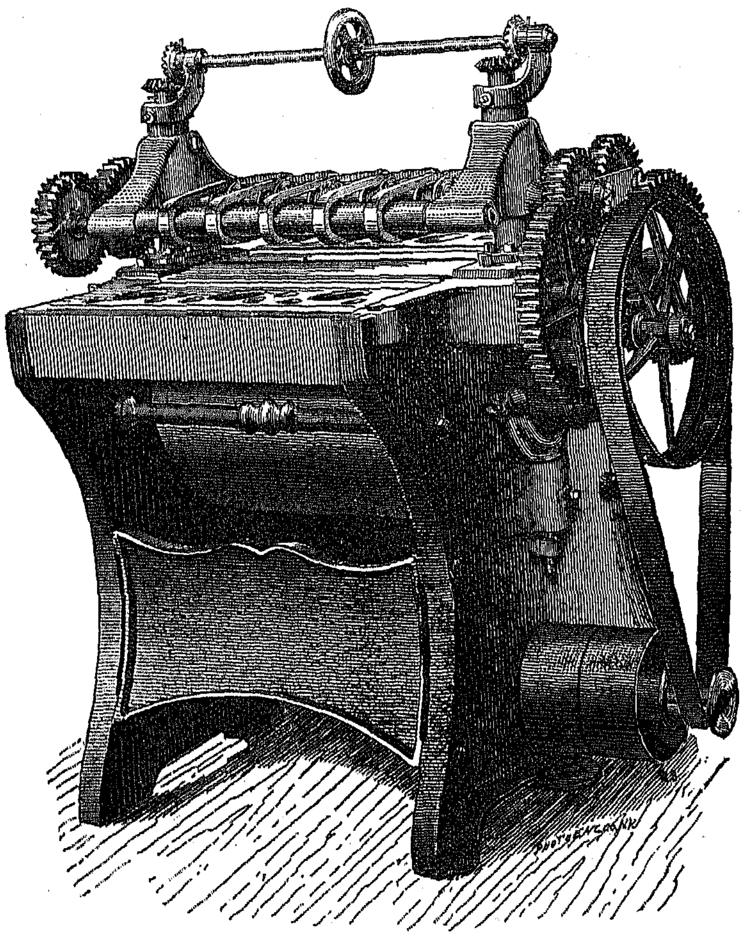

Fig. 569.

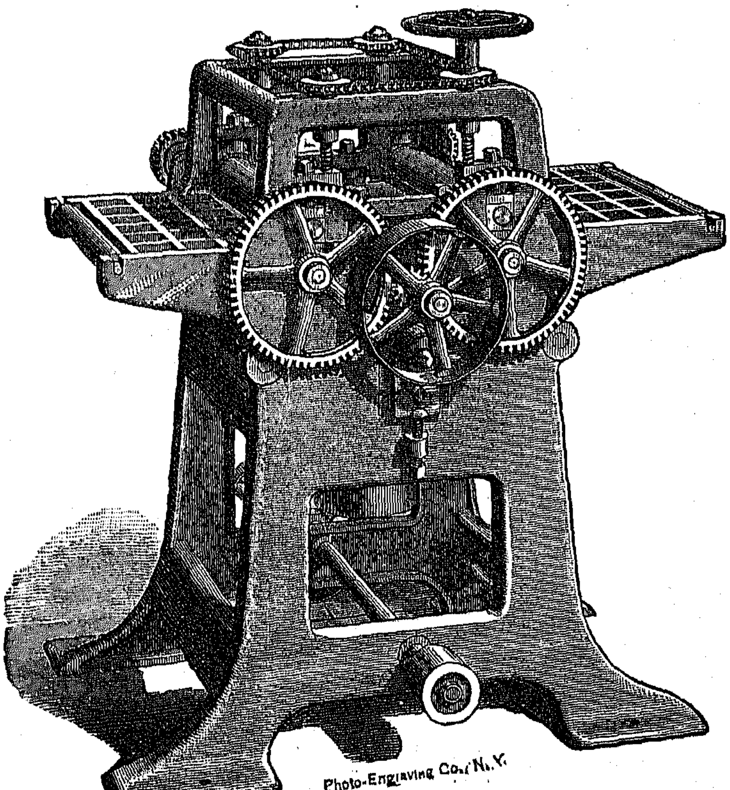

Fig. 570.

§ 56.

The same considerations have acted as in the first part to deter from detailed allusion to the linear capacities of the tools described. They are accessible to those who look for them. But it is difficult to leave the class of wood-working machinery without referring to two points, which are indicative of recent progress. The first is the change by which the manufacture of this class of machine has passed from the hands of wood-working operatives into those of mechanical engineers. The first machines were built with wood frames, and were open to all the objections which follow from the use of a material which is elastic and is susceptible to atmospheric influences. The newer machines are more deserving of their name. They are built of steel and iron, by specialists in their manufacture, and with the same care in fitting which is called for in metal-working tools. A much higher grade of work must result, which will favor successful competition in critical markets. The second point to be noted is in part a consequence of the first. It is the gradual increase in speed of feed, and the capacity for enlarged output, due to that increased speed and to better construction. The increased output makes it possible for the purchaser to pay for a better machine, and the better machine cheapens the product by a wider distribution of the interest account and of the diminished repair account. In the earlier days the excuse for the purchase of cheap machinery was that new improvements would make it necessary to exchange old tools before they had paid for themselves. Tool-builders must always meet the demand for the grade of machine wanted, and these two causes interacted. But of later years, the better judgment of consumers, and the more advanced skill of specialist builders, has given an impulse in the direction of true progress, and the engineering community is realizing more fully the truth of the old aphorism, "the best is the cheapest".

INDEX TO MACHINE-TOOLS AND WOOD-WORKING MACHINERY.

M.

N.

O.

P.

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S.